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Brief Notes on European Coal Mines

Labor Abroad Is More Thoroughly Organized, and Taxes Are Higher; However, the Coal Industry There Is on a More Profitable Basis

BY FLOYD W. PARSONS

It is customary for American engineers to think of European coal-mining practice, as being so far ahead of methods at home, that the attainment of a similar standard of efficiency is the great goal beyond which nothing is to be expected. This view is largely caused, if not confirmed, by annual statistics showing that we kill more than two men in our mines, to one similar fatality in Europe. To be more precise, the death rate of the United Kingdom is 1.31; Austria, 1.27; Belgium, 1.04; France, 1.10; Germany, 2.55, and for the United States, 4.66. Reasoning from such facts, the natural conclusion follows that we are more careless, and as a consequence less efficient.

We attempt to console and excuse ourselves by calling attention to the double quantity of coal each of our miners produces. We further declare that our growth has been so rapid, we have not had time to organize carefully and perfect our methods. We proudly explain to our English cousin that in 1800, Britain produced 10,000,000 tons of coal, Belgium, 2,500,000 tons, and Germany and France each under a million tons. In 1850, Great Britain produced 50,000,000, Belgium, 6,000,000, Germany 6,000,000 and France, 4,500,000 tons. At this time the United States produced less than 4,000,000 tons of coal. In 1900 the United States produced 40 per cent. of all the coal output of the world, while at present we are producing approximately one-half of the world's supply, or nearly 500,000,000 tons.

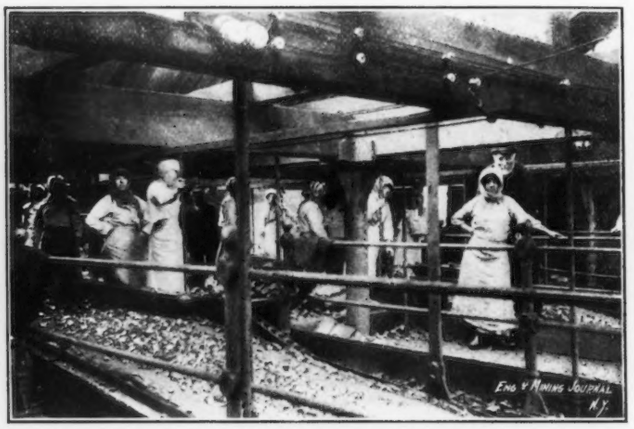
Notwithstanding such self-satisfying figures, the controlling interests in America's coal industry must eventually come to recognize that our boasted success is only on the surface. Eliminating our shocking death rate, and not countenancing the criminal waste that has occurred, we have, in this industry, made but small progress toward commercial success. Even the foreign engineer, who views with scorn our recklessness, little understands how trifling has been our monetary return for the great effort put forth, and the natural resources used up. It is true

SHOWING SURFACE PLANT AT MAYPOLE COLLIERY, NEAR WIGAN, ENGLAND, AFTER EXPLOSION WHEN ALL MEN UNDERGROUND WERE KILLED

that immense profits have been made in coal-land speculation, but the real industry lies in the employment of thousands of men in the production of coal, and not the exchange of coal lands. It can be argued that our cheap fuel supply has redounded to the benefit of all our other great industries, but that is small consolation to the man who is devoting time and money to the unprofitable exhaustion of a limited resource.

Optimism is the only popular sentiment at present, and the pessimist is regarded with suspicion. Such cheerful philosophy, however, does not justify a disregard of actual conditions. It requires some argument to explain why the total value of the coal output for Great Britain in 1907, should increase nearly $40,000,000 more than did the value of the coal produced in the United States during the same period, although in the latter country, the increase in the quantity produced was nearly four times as great. Competition is said to be the life of business, but it is often accompanied by disaster when allowed to continue unrestrained. The application of the survival of the fittest sometimes results in the destruction of all, and most always in the crippling of the victor. The man who has lived on plain food, does not have the appetite and tastes of an epicure; likewise, coal operators in America are glad to barely pull through, and have not been trained to expect much. (I am referring to our bituminous industry.)

COLLIERY LASSIES PICKING COAL AT ASPULL COLLIERY IN LANCASHIRE



VIEW INSIDE SCREENING AND TIPPLE PLANT AT NO. 4 PIT OF THE ASPULL COLLIERY NEAR WIGAN

Conditions Existing in Great Britain

The coal seams in England, Scotland and Wales do not differ materially in position, thickness or quality from coal beds in America. Most of the development abroad is done through shafts, but whole districts in America are being worked in the same way, and at a corresponding depth. The foreign miner receives on an average about 45c. for each ton mined, and the miner in America receives practically the same. The miner abroad does not mine as much coal and, therefore, receives a smaller monthly income, but his reduced expenses practically balance this loss. Royalties in Europe compare quite favorably with such payments in America, so that practically the only apparent difference is in the taxes, and the expenditures due to the employer's liability act, which expenses are somewhat greater abroad than in America. The difference, however, is only a matter of cents per ton and is partly offset by reduced management costs, and the cheaper skilled labor.

The American operator producing the best grades of eastern bituminous coal receives from 60c. to $1.10 per ton at the mines. A close average price is about 90c. per ton. The British coal producer receives from $3 to $3.75 per ton at the mines with $3.25 as a low average estimate. It is, therefore, evident that the foreign operator receives $2.35 more for each ton of coal produced than does the American operator for an equally good product.

What Accounts for the Difference in Price Received

If I were trying to account for a difference of a few cents a ton in the price received by European operators as compared with prices paid producers at home, no such general analysis as the foregoing would be accepted; however, it is certain that the most carefully detailed examination will add but immaterially to the foreign cost of production. It can be argued that timber costs considerably more in Europe, but on the other hand, it is true that this timber expense is largely repaid by an increased percentage of extraction. The powder cost in the average European mine is less per ton than in the American mine. This is due to the superior method of mining (generally longwall) and to the fact that no shots are fired from the solid. At a mine in Lancashire, where normal conditions existed, the cost of powder per ton of coal over a period of two years was about 3.75c. At one Scottish mine, where the coal breaks down easily after being undercut, the cost of powder last year averaged less than ½c. per ton.

The Advantage of Undercutting

A visit to European coal mines leaves the observer with two impressions stronger than any others; (1) the advantage of working longwall where possible; (2) the conviction that shooting from the solid is a crime, of which America alone is guilty.

In some of our greatest coal-producing States, 75 per cent. of the total output is secured by shooting from the solid. How can we, therefore, expect to do away with the horrible disasters due to blown-out shots? Safer explosives will help slightly, but the cure lies in undercutting the face.

I firmly believe that American operators generally fail to realize the commercial advantages of undercutting, aside from the consideration of safety. If even 5 per cent. more round coal is produced by shooting after undercutting, and if slack brings only one-half the price of round coal, then it is plain to be seen that there alone is one great compensation for the cost incurred in undercutting.

American operators have come to believe that longwall work is only applicable to an exceptional seam, where the bed is very thin. European operators reverse this belief, and consider pillar-and-stall (room-and-pillar) as only adapted to special cases where the coal is rather thick (certainly above 6 ft.), and where the roof is exceedingly strong, and the seam so clean that no material for gobbing is available. In this connection it may be stated that some mines on the Continent are working longwall, where the seams average considerably more than 6 ft., and where all the exceptional conditions just mentioned exist. In these cases, material for gobbing purposes is flushed in from the surface.

What Have We to Learn From Europe?

We can teach European operators how

to hustle, and we can show them a way to double their output in a decade, but they can teach us how to mine profitably, efficiently and safely. America is a synonym for hurry, and our foreign competitors view our growth with astonishment. It is practically certain, however, that even should labor conditions here and abroad be brought to a common basis, ages would pass before Europeans could be imbued with the spirit of hustle now so characteristic of America.

Our phenomenal growth in coal mining has worked to our own disadvantage. We lack the organization common to the industry abroad. It is really better, from the standpoint of the operator, to mine 100 tons of coal at a profit of $1 per ton, than 1000 tons at a profit of 10c. per ton. This theory may be disputed, in general, on the grounds of the greater stimulation, the greater good; but such an idea is absurd when applied to the development and exhaustion of a limited natural resource.

by a referee or by arbitration, the decision being accepted as final.

The most recent important act relating to mining in England is the "Eight-Hours Act." The first results of this law have been to reduce output and raise coal prices. The condition of absolute control under which the industry in England exists, cannot be more forcibly shown than by calling attention to the flexibility of prices, which so quickly discount adverse conditions.

The greatest danger to mining in Europe lies in the possibility of too much government regulation. In America we have too little inspection, and in addition only indifferent enforcement. With indifferent regulation, the danger comes from the miner being left to his own resources and disaster results. With too much government inspection, responsibility is shifted to federal officers, and the danger then comes from the management becoming careless through relying on the government inspectors.

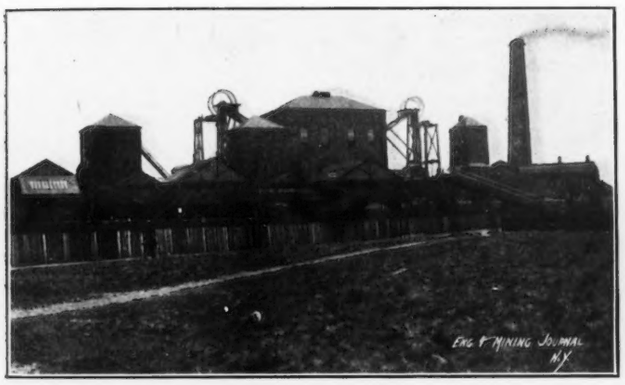
revision of the State mining law should be made. The revision was reported at the recent session of the legislature, but failed to pass. Recently Chief J. E. Roderick of the Department of Mines issued the following instructions to the mine inspector in charge of the district.

"I desire to call your attention to the mutual agreement or understanding arrived at some time ago between the Department of Mines, a few of the inspectors and several of the operators or managers of the coking-coal region, viz: That blasting coal from the solid could be continued temporarily, providing that the blasting was done by shot firers at night, when employees were out of the mine." It was also understood "that any one of the parties could terminate this agreement at any time on reasonable notice."

"This mutual agreement, so far as the Department of Mines is concerned, will terminate on the 15th day of August, 1909, and you are directed to govern yourself accordingly. On and after August 16, 1909, you are notified that part of Rule 4 of Article 20 is to be considered in full force as if no understanding had ever existed. Said part of Rule 4 reads as follows:

"He (the mine foreman) shall direct that all miners undermine coal properly before blasting it, and that blasting shall be done at only such hours as he (the mine foreman) shall direct. * * *"

It is altogether probable that a conference between the operators of the district and the State Mine Inspectors in the coking-coal region will be held in the near future at which the phases of the mining laws applying to the region will be discussed and an effort made to arrive at an equitable arrangement by which the law will be observed in all its details without friction.



THE SURFACE ARRANGEMENT AT AN ENGLISH COLLIERY IS GENERALLY FAR AHEAD OF THE AMERICAN INSTALLATION

SURFACE PLANT AT ONE OF THE WIGAN COAL AND IRON COMPANY COLLIERIES IN LANCASHIRE

Conditions in Europe and America are not so dissimilar that we can afford to ignore the lessons experience has taught our foreign competitors. Only a cursory glance at samples of our mine laws, and a brief investigation of laws governing coal mining abroad, is necessary to prove the superiority of the foreign rules.

The Employer's Liability

Outside of direct laws governing actual mine development, the most important act with reference to coal mining in England is what is known as "The Employer's Liability Act." This law requires the employer to pay a pension to any employee injured in the regular performance of his duty. No other law has ever acted so speedily and efficiently to curb reckless mining and reduce accidents, as this measure. It has placed a considerable burden in the way of expense on mine operators, but this has not occurred without some compensating advantages. English mine law is administered most fairly, and practically all questions in dispute are settled

Female labor is no longer permitted underground in Great Britain, but is used largely on the tipples and about the surface plants. This labor is paid from 35c. to 75c. per day, and will be further discussed in a subsequent article.

Shooting Off the Solid

A little over three years ago the Pennsylvania mine inspectors charged a number of superintendents and mine foremen in the Connellsville district with violation of the mining law, in permiting shooting from the solid and a number of cases were put into court. The operators insisted that the practice was an old one and was safe, pointing out the few accidents in the coke region mines, and insisted that to undercut the coal before blasting would mean a considerable loss of time, and increased labor and expense. A temporary agreement was then made, suspending the cases until the proposed

In underground work, the unskilled should be taught to consider all electrical apparatus as "live," for in this way only can security from shock be attained.

The Phenomena Preceding Gas Explosions

The Dangerous Periods for Working Gassy Mines May Perhaps Be Foretold; the Relation of Sidereal Influences to Gas Explosions

BY FRANCIS LAUR

I have already had the honor to develop before the Société de l'Industrie Minérale my favorite theme, viz., the relations which exist between barometric depressions and explosions of gas. Since my communication to the Academy, about 1879, I have had the happiness to see, little by little, this theory almost universally adopted. In order to prevent a too easy generalization from it, I am now obliged to state it with more precision and to say that not all abrupt barometric falls lead to gas explosions, for it is necessary that these falls be preceded by a prolonged period of high pressure, i.e., of compression; and that after having once halted, the fall may proceed with no danger of an explosion. After periods of high pressure it is only the first barometric drops that are to be apprehended. Prolonged pleasant weather is one of the most certain warnings, but there are others no less interesting which I desire to set in the light. These are earthquakes and perhaps other sidereal phenomena.

Already an idea has been suggested, one of whose promoters was M. de Saintignon, that sidereal influences may act upon the central liquid core of the earth as they do upon the ocean, producing internal tides, movements in the crust, and consequently earthquakes. Against sun spots also strong accusations have been brought.

An interesting problem is, therefore, presented to my mind: In what order of sequence do these phenomena—conjunction of stars, sun spots, earthquakes, periods of high pressure, barometric drops, gas explosions—follow each other? Are their manifestations governed by chance, or, on the contrary, is there a chronology in their succession? And then is it not possible to foresee long in advance the periods that are dangerous for the working of gassy mines?

It is evident that such a study should offer some interest and perhaps complete the theory of abrupt barometric falls. That is why we have undertaken it for the Industrie Minérale.

First Relations Noted in 1875

It was about 1875 that public attention was first attracted in England by a sequence of coincidences which took place at that period between a succession of earthquakes and violent gas discharges which desolated certain collieries of Outre-Manche [upper Manchester]. The author of these observations, who remains unknown, published them in an English mining journal.

As early as 1874 S. de Rossi called attention to periods of activity inside the earth (varying from a few days to a week at most) during which lively agitation of the pendulums coincided with series of terrestrial shocks—earthquakes, volcanic eruptions, barometric falls and the like.

At the end of 1880, when the Anderlues disaster occurred, M. de Rossi renewed his campaign for applied study of endogenous meteorology, and in a conference at Amsterdam, 1883, he demanded the addition of instruments for internal auscultation to those for giving atmospheric and other warnings of gaseous discharges. Unfortunately this appeal was not listened to, and implacable routine prevailed.

Many years ago I demonstrated the relations which exist between abrupt barometric falls and gas explosions. In 1879, while studying the eruptions at the unusually gassy mineral spring of Montromd, I demonstrated in numerous communications to the Academy the relations existing between frequency of gaseous eruptions, barometric depression and seismic movements. Thus, the earthquake at Ischia was indicated by a violent discharge of gas at the Montromd spring. From that time I established a system for predicting gaseous discharges which has given results sometimes remarkably precise, as has been shown by the Geological Society of Belgium in its bulletins.

Academy of Sciences, Paris, Interested

In 1883, that eminent geologist and French mining inspector, M. de Chancourtois, from the lofty tribune of the Academy of Sciences, Paris, advised an investigation of the possible correlations which he suspected to exist between the data of terrestrial seismology and gaseous discharges.

The following year, in 1884, Japan outstripped Europe, and Mr. Miller, the learned English seismologist, was commissioned to organize a program for the protection of gassy Japanese mines. Some steps were taken toward the execution of his plans. In England, Walter Brown entered the same field, and, impelled by him, since 1885 the English commission on gas, assuming certain gaseo-seismic relations to be probable, has also concerned itself with the question.

In France, meanwhile, the seed planted by M. de Chancourtois and myself had sprouted, and in 1886 there appeared in *Ann. des Mines* an interesting report by MM. de Chancourtois, Chesneau and Lallemand who had been officially sent to Italy and Switzerland to study the organization of the geodynamic and microseismic stations of those countries where earthquakes are frequent. This research by the learned French specialists resulted in the establishment in the northern coal basin of a double investigating station comprising the Douai observatory and the Hérin shaft, one of the Compagnie d'Anzin's most gassy mines. Unfortunately the instruments used were not of a kind most favorable to this sort of study and, further, the gaseous manifestations in those quarters did not belong to that type of discharge (only too well known in Belgium under the name of "instantaneous disengagement") which demands careful study by this new method of gaseo-seismic relations.

Forel's Law

The idea gained ground in spite of unfavorable circumstances, and in consequence of the great earthquake of Feb. 23, 1887, felt on the Mediterranean coast at Nice and in Italy, Professor Forel, as the conclusion of a study published by the Academy of Sciences, Paris, made the following announcement which is known by the name of Forel's Law: "It is necessary to take double precautions against gas on days following an earthquake whose seismic area reaches the territory of the mines in question."

The *Ann. des Mines*, 1888, contained a study by M. Chesneau, analyzing the information supplied during 11 months of 1886 by the Hérin station. The diagrams obtained established, in spite of the unfavorable conditions already noted, interesting and repeated agreements between the micro-seismic disturbances observed during this period and the phases of intensity of gaseous discharge. M. Chesneau, as a conclusion, was led to recognize a certain relation between the micro-seismic movements and the discharges of the gas. The published diagrams show, on their part, that the maxima of gaseous discharges are found to be very regularly preceded or accompanied by strong seismic agitations. There is even a case where, in the diagrams taken by M. Chesneau, the precedence of the maximum effect of the seismic phenomenon to the gaseous phenomenon appears in a striking manner.

NOTE—Abstract of a communication in the *Bull.* de la Société de l'Industrie Minerale, June, 1909.

Nine Hours' Warning

To fix these ideas it is well to give a few examples: During the period from Dec. 7 to 10, 1886, a veritable tempest in the earth coincided, in western Europe, with an intense barometric depression and with the appearance of decided gas discharges. Now, the lines of the diagram which give the parallelism between the barometric changes, the gas liberation at Hérin and the micro-seismic movement noted at the Douai observatory, clearly show that the maximum and truly abnormal period of seismic agitation (which therefore constituted a true warning) preceded by nine hours the dangerous (3 per cent.) maximum of gas discharge in the air of the mine.

We find in one of the works of Mr. Van den Broeck[1] an exposition of the gaseous phenomena which, during the same troubled period, were manifested in France, Belgium and England, showing that there was no possibility whatever of a simple coincidence. Various writers, such as Messrs. Canu, Doneux, Laur, Milne and Zenger, have defended the gaseo-seismic relations and it was for the purpose of practically explaining the problem thus presented—based upon the precise observations made at the Hérin shaft and elsewhere—that the Belgian Geological Society, impelled by its general secretary, E. Van den Broeck, decided to take up the question, submitting it to direct, systematic experimentation.

Permanent Committee Established

The statement of reasons presented by Van den Broeck, at the special meeting of the aforesaid society, June 14, 1898, brought forth valuable encouragement from M. Nyssens, then Minister of Labor and Industry, and led the Belgian Geological Society to express a desire for the establishment, with a view to gas investigation, of stations for endogenous meteorology in the Hainaut coal basin, correlatively to the creation of a geophysical station in the same region, called for by the Belgian Astronomical Society. In order to accomplish this end the society decided to create a permanent section charged with the study of the question.

At the meeting of Aug. 2, 1898, a program formulated by Léon Gérard and E. Van den Broeck for studying the phenomena of gas discharge was tentatively adopted. Long and interesting discussions conducted by M. Harzé, on one part, led to the elucidation of various technical points and to the elimination of some misapprehensions from the question. A subsidy of 1000 fr. was allotted for the studies in prospect, thus bringing the question into active consideration.

The permanent section on gas, established by the Belgian Geological Society, definitely adopted, at its meeting of Nov. 14, 1898, the program of inquiry for the study of gaseous phenomena.

Widening Field of Research

But the researches made by the promoters of the enterprise showed a broadening field for investigation. Thus, to the data of a micro-seismic nature, it was necessary to add that furnished by the variations of the magnetic elements, which in turn led to the necessity of increasing the scientific equipment of the stations that were to be established. This was demonstrated by E. Van den Broeck in a study entitled "The Gaseous Predictions. Preliminary Researches Occasioned by the 'Warnings' of M. Francis Laur," and with the subtitle, "Analysis of Complementary Facts and Observations Relative to the Exposition of the Data Furnished by the Magnetic Elements."

The inevitable period of incubation and material difficulties encountered by every new enterprise, prolonged here by researches on avoidance of danger from electric lighting in a very gassy mine and also by the quest for indispensable financial resources, brings us to Mar. 27, 1901, the date of the meeting of the Belgian Geological Society, at which M. Eugène La Grange presented his "Report Relative to the Creation of Seismic Stations for Study of the Conditions of Discharge of Gas."

Deep-level Experimental Stations

The first thing to do, as has already been mentioned, was to organize—thanks particularly to the friendly coöperation of I. Isaac, manager of the Agrappe colliery—the first deep or especially gaseo-seismic geophysical station. This was to be established at a depth of 819 m. in the heart of one of the most gassy collieries in the country. A committee of 12 persons, including various specialists, was nominated by the society to aid Eugène La Grange in his difficult task.

At the meeting of June 21, 1901, M. Van den Broeck, in explaining the state of the question at that time, announced the practical possibility of putting it definitely into execution, thanks to the subsidy of Hainaut province (1000 fr.) and to the generous gift of Messrs. Montefiore-Levy, Ad. Urban and Aug. Beernaert. The organization of the two stations decided upon by the society at Frameries and Quenast was thus assured.

Further Ad. Greiner, general manager of the Cockerill company, announced that, aided by some friends, colliery operators of the Liège basin, he placed it in the committee's power to organize also, at the cost of this local group, a gaseo-seismic underground station identical with that of Agrappe to be installed in a gassy mine of the Liège basin, and at the same time perhaps a complementary outside comparison station. The installation of the two seismic stations of Quenast and Frameries occupied much time but it has been completed. The Hibernia mine has established an observatory of this sort.

The Question at Present

Such are the ideas that have, so to speak, placed the question on the order of the day. Minds in all countries have united their efforts to solve the problem. Very recently, in the Engineering and Mining Journal, Feb. 20, 1909, W. A. Spalding has furnished striking statistics which reply to doubts that the new theory has raised in many intelligent minds. (Here follows a translation of Mr. Spalding's article, practically in full. M. Laur then proceeds as follows:)

It now seems established that the chronology of the phenomena preceding gas explosions is as follows: (1) A period of high barometric pressure; (2) earthquakes; (3) abrupt barometric depression; (4) explosion of gas. But today there are being added to the terrestrial phenomena aforesaid, extra-terrestrial phenomena. To the actions and reactions of the internal atmosphere upon the external atmosphere, and reciprocally, are added sidereal and astral actions. Let us examine them.

Seismic Activity Periodical

The Abbé Moreux, director of the Bourges Observatory, has thus summed up this theory:

"That there are periods around which are grouped volcanic and seismic activity, can no longer be doubted. To be convinced of this truth, it is enough to read the newspapers. The report of an earthquake is never an isolated fact. I could cite a hundred examples to that effect. Let us confine ourselves to recent facts.

"Nov. 12, 1908, earthquakes in Belgium, Germany, Westphalia, etc., lasting all the month." (We here interpolate says M. Laur the gas explosions in the Marianna mine, at Pittsburg, 125 killed); "Nov. 19, disturbances at Leipzig, in western Saxony, in Thuringia, etc. . . . ; Dec. 2, earthquakes at Reggio; Dec. 7, at Galati." (We interpolate here, says M. Laur, the terrible explosion of Dec. 11 in a colliery of Benavon, in Monmouth); "Dec. 20, earthquakes in Maine-et-Loire." Then the manifestation became general. Disturbances were noted in America, and several days later came the horrible news of the catastrophe in Sicily and Calabria.

Sun Spots Before Mine Disasters

In support of his theory on the relations between mine explosions and sun spots, M. Moreux recalls that "In November last, the sun presented two enormous spots with magnetic deviation, and on Nov. 12 the mining disaster of Hamm, Westphalia, occurred. April 20, 1896, violent earthquakes were produced at the same time as the disaster in the Ciphy mine, and at Micklefield. July 3, 1908, earth-

[1] Van den Broeck, "La Météorologie endogène et le Grisou." Address made, July 3, 1898, on the occasion of the extraordinary session at Béthune of the Société Géologique du Nord. *Ann.* de la Société Géologique du Nord, Vol. 27, 1898; pages 150-174.

quakes in Italy and Austria accompanied a gas explosion in a Belgian mine where hitherto no gas has been detected. The disaster of Courrières, March, 1906, occurred at a time when the sun was in an intensely critical period.

"It is the periodical repetition of the troubles observed in September, 1905, March, 1906, and August, 1908; and we would be able, by going back to earlier years, to extend the list indefinitely. Who, then, will pretend that it was a current of molten lava which, through underground ways of several thousand kilometers, acted at the same time at points often 4000 to 5000 km. apart?

Old Hypotheses Discountenanced

"That hypothesis is as puerile as one which requires the ocean water to enter by appropriate crevasses as far as the incandescent core, situated 70 km. deep and at 200 km. from the coast. I here refer to the equatorial volcano of Sangay, whose activity has not varied within human memory.

"Does not the water wash at all times those coasts most devastated by earthquakes?[2] And if it is an important factor, there is yet to be explained how, in certain periods, the tremors are felt simultaneously at widely remote points. There is certainly a periodicity in the phenomenon, but if this periodicity exists, we are led to seek the law by which it is governed.

"Although statistics seem to indicate that the earth quakes continually, they permit a deduction that though the phenomenon takes place more often in winter than in summer (this is true also of gas explosions), the intensity of it is 3½ times greater in the hot season. Further, earthquakes come oftener in the night than in the day, and in the morning than in the evening.

Solar Activity and Seismic Disturbances

"Of all phenomena, atmospheric electricity agrees best with the distribution of seismic disturbances. We know, moreover, that great electric and magnetic manifestations are due to the sun. I have, therefore, been brought to the conclusion that the cause of the phenomena has a source outside of the earth, and that the sun plays an important rôle in the periodicity of volcanic phenomena and earthquakes.

"We know that the solar activity passes through a minimum every 11 years, and, indeed, eruptions come most frequently in the epochs when the activity of the sun is feeblest. This law is almost without exception since 1610, the date when observation of solar spots began. Earthquakes occur especially at the times when the solar activity varies, either increasing or decreasing. This theory has already allowed me to predict several seismic manifestations.

1912 an Earthquake Year

"In 1905 the solar activity, then at its maximum, abruptly diminished and violent earthquakes occurred. It will continue to decrease until 1912, the period at which it will reach its minimum, and thereafter will ascend. The volcanic disturbances will group themselves around that fatidical year.

"But the solar activity does not decrease abruptly nor according to a regular curve; it often turns very noticeable somersaults like the pulses in a disease. The most striking somersault generally takes place three years after the maximum. We are now at the full crisis of earthquakes, and present phenomena only too sadly justify this general law. We have, therefore, to expect further seismic disturbances, which will not decrease until the end of 1909. Alas, we shall fall into the minimum phase of the solar crises, and eruptions will resume their fresh vigor.

"Thus marches the history of the world. When will come the day in which humanity will be persuaded that the science for them to hold closest to heart is the science of the sun?"

Conclusion

Gentlemen, behold how we are connected with the phenomena of that marvelous star around which we roll. Solar spots evoke the seismic disturbance and that evokes the abrupt barometric fall and the gas explosion. And all this is governed by a star.

Behold how we are compelled, we engineers, to become not only meteorologists but astronomers. Thus ever the horizon is widening around us, and to be at the top of our profession there are constantly required of us new efforts and new studies. It is the law of human labor.

I have desired only to outline before you the relation and chronology of the phenomena with which our workmen's lives and our own lives are bound up. True enough, many objections will present themselves to your minds, many doubts will have their day, but you will admit, like myself, that the grand scientific liberality of our Industrie Minerale ought to take up all ventures, all theories, at their inception. Who knows, in fact, but that they may be able to lead us in the way of progress?

The Heroult electric furnace installation which the Steel Corporation is making at Worcester, Mass., will probably not be ready for operation before Oct. 1. The furnace will be operated on electric current secured from an outside source, and considerable delay has arisen in this connection.

[2]This sentence is rather doubtful and might read: "The water does not always wash those regions most devastated by earthquakes."—Translator.

Colliery Notes

It is customary to consider 1000 amperes per square inch as the carrying capacity of cables, however, it has been proved that the carrying capacity increases beyond 1000 amperes per square inch for the smaller sizes, and decreases for the larger sizes. Similarly, the insulation resistance increases with the lessened diameter of the wire.

The deliveries of anthracite by regions for the year 1908 are reported by the Bureau of Anthracite Statistics as below, in long tons:

Region:	Domestic.	Steam.	Total.	Per Ct.
Wyoming...	24,061,955	14,810,340	38,872,295	60.1
Lehigh.....	4,544,588	3,241,667	7,786,255	12.0
Schuylkill..	9,712,782	8,293,682	18,006,464	27.9
Total.....	38,319,325	26,345,689	64,665,014	100.0

Domestic sizes include chestnut and all over; steam sizes, pea and all smaller.

The following table, prepared by the Bureau of Anthracite Statistics, shows the percentages of the different sizes of anthracite made and shipped during 1908, by regions:

	Wyoming.	Lehigh.	Schuylkill	Total.
Lump.....	0.8	1.5	1.5	1.1
Broken.....	5.2	8.1	5.7	5.6
Egg.....	12.6	12.5	11.0	12.1
Stove.....	20.8	16.6	17.8	19.5
Chestnut.....	22.5	19.7	18.0	20.9
Total domestic.....	61.9	58.4	54.0	59.2
Pea	12.0	13.6	13.9	12.7
Buckwheat.....	12 5	16.2	18.6	14.7
Rice and barley.....	13.6	11.8	13.5	13.4
Total steam.....	38.1	41.6	46.0	40.8
Total	100.0	100.0	100.0	100.0

The Schuylkill region shows much the highest proportion of small sizes made.

In the year 1800, the countries which produced coal were Great Britain, Belgium, France and Germany; the outputs were: Britain 10,000,000 tons, Belgium 2,500,000, France and Germany about 1,000,000 each. At this time Watt's steam engine was in use and coal was used for steam raising, for iron smelting and other metallurgical processes, as well as for domestic purposes. In 1850, Britain produced 50,000,000 tons, Belgium 6,000,000, France 4,500,000 and Germany about 6,000,000 tons. At this time the United States had a production of about 3,500,000 tons, and the world's coal output was under 75,000,000 tons. The real coal era began about 1860, when the world's combined output was 130,000,000 tons, with Britain producing about two-thirds of the total. As American operators now produce upward of one-half billion tons annually, or approximately one-half the world's total output, it would appear that we have little cause for complaint if we view the industry from a standpoint of comparative or superior growth.

Free and Hindered Settling of Mineral Grains

Theory and Principles Discussed. New Equations Derived Theoretically, Worked out from Experiments and Applied to the Classification of Ores

BY ARTHUR O. CHRISTENSEN*

At the meeting of The American Institute of Mining Engineers, held in New York, April, 1907, Prof. Robert H. Richards, of the Massachusetts Institute of Technology, presented a paper entitled, "Velocity of galena and quartz falling in water," in which he described a series of experiments carried out under his directions. Since that time his interest has been drawn to work on the laws of hindered-settling. He has invented a hindered-settling classifier, and has done considerable experimental work to find the hindered-settling ratio of quartz and galena.

While working in Professor Richard's employ on this classifier I became interested to work out this ratio mathematically, and, if possible, the theoretical, i.e., mathematical, explanation of this hindered-settling action.

This paper first gives in plotted form—Plates I to IV—data taken from the paper by Professor Richards on the velocities of galena and quartz grains settling freely in water; along with a discussion of free-settling, and the derivation of formulas to express these velocities. With these as a basis, a method is given for working out the hindered-settling velocities and general conditions for quartz and galena, or incidentally any two minerals.

FREE-SETTLING

By the term, velocity of a grain, is meant the velocity which a grain attains when falling in water. It is the same thing as the velocity of the rising current necessary to keep the grain from either sinking or being carried up. This maximum velocity of the sinking grain is attained after a fall of about 2 ft., depending on the size of the grain.

In Plates I to IV, inclusive, the little cross marks (x) represent the average diameter corresponding to the horizontal position of the cross. To judge the reliability of these averages, or any law derived from this data, it seems necessary to know the average deviation of the individual velocities from these averages as given. Therefore, in Plate III, in each case the average deviation of the 100 grains is denoted by a dot and circle on each side of the cross. This deviation in velocity is due largely to the differing shapes of the grains, but also is due in part to the range in the size of the grains taken. For example, the grains plotted as having an average diameter of 11.93 mm. are, in fact, anywhere from 11 to 12.9 mm. in size. A closer sizing would give a smaller deviation in velocities. As it is impossible to calibrate the screens used for sieving precisely, variations of averages from the curve are, in part, due to this error.

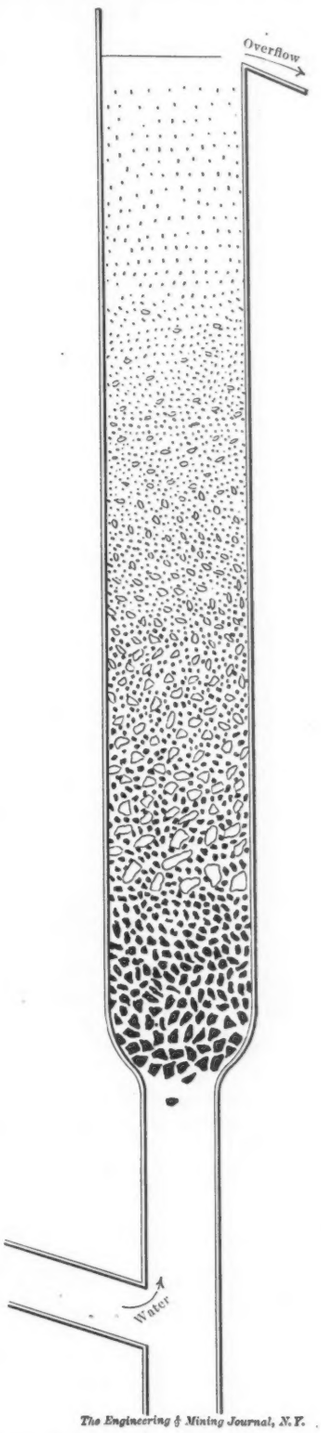


FIG. 1. CONDITION IN HINDERED SETTLING

In the case of the four largest sizes of galena grains in Plate III vertical lines represent by their length the number of grains having velocities corresponding to the horizontal position of these lines. An examination of these shows how the bulk of the grains have velocities greater than the average. It is a question whether to plot the velocities from the mass of grains in each case, or to take the average velocities, which are dragged down by some odd shaped grains lagging behind the rest. An upright cross (+) represents the velocity of the bulk of the grains. The curves plotted are compromises between this and the average.

In making Plate III especial pains were taken to show that the velocity of any size of quartz or galena grain can be stated quite accurately from its diameter. The mathematical curves representing the velocities as plotted on Plates I and III are seen to lie well within the average deviations of the velocity in each case, and in most cases between the average velocity and velocity of the bulk of the grains.

Rittinger is still often quoted as having established the law for the velocities of grains of mineral falling freely in water. He assumed the grain to be a cube, falling with faces horizontal and vertical, in which case, falling at maximum velocity, the weight of the grain in water is equal to the area of a face, multiplied by the head of water required to hold it up. This head is here a velocity head, being known from the formula:—

$$V = \sqrt{2gh};\ h = \frac{V^2}{2g}.$$

Thus

$$D^3(G-1) = \frac{V^2}{2g}D^2;\ 2gD(G-1) = V^2;$$

$$V = 140\sqrt{D(G-1)}$$

D = diameter of the grain in mm., in this case the length of an edge of the cube. G = sp.gr. of the mineral. Therefore $(G-1)$ is its specific weight in water. V = velocity attained in mm. per sec., or the current necessary to support the grain. g = acceleration due to gravity: i.e., 9800 mm. per sec. As this equation gives velocities far too high Rittinger substitutes for the 140 a factor C which varies from 61 to 87, according to the shape of the grains. In any case, whether we assume the grain a cube falling with one corner down, as it would naturally fall, or a sphere, or an ellipse, his formula, de-

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rived from a purely theoretical consideration, is the equation for a parabola. No parabola, however, can be plotted which will even lie between the average deviations of the velocities of the grains. In other words, the experimental precision

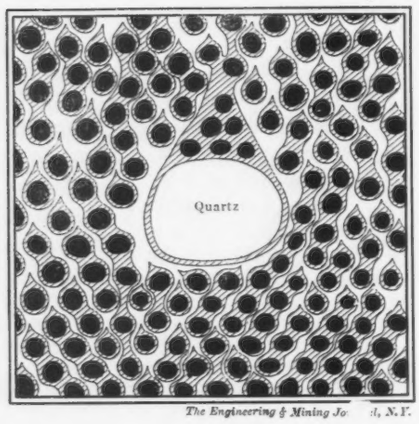

FIG. 2. GALENA AND QUARTZ GRAINS SHOWING STILL WATER

warrants an equation much more precise than any of Rittinger's.

If we sieve a crushed mineral through a series of seives and weigh a known number of the different sizes of grains we would probably expect that the weights would vary as the cube of the diameter varied, and would follow the equation $W = \frac{\pi D^3}{6} G$, where W is the weight of the grain, D the mean between the diameter of the last sieve which the grain passed and that of the sieve which it was caught on, and G is the sp.gr. of the mineral in question. This, however, is not the case. Here the cleavage of the mineral comes into play. The weight of a cube is almost twice that of a sphere of given diameter. The weight of an ellipsoid is greater or less than that of a sphere depending on which axis of the ellipsoid we take as its diameter.

If we take a mineral sized through a series of sieves, and weigh a definite number of each size grains, a plot showing the weight of the sizes will vary as the cube of the diameter of the grains, but will not coincide with the formula $W = \frac{\pi D^3}{6} G$, which assumes the grains spheres. Of course the curve will depend, in part, on how the mineral was sieved. By the gentlest sieving the weight of the grains will be lower than if rough and repeated sieving was done. By using comparatively gentle sieving it has been found that for quartz, $W = 1.15 D^3$, expresses the weight of the grains in terms of its diameter, the quantities being in millimeters and milligrams. For galena the weight is $W = 4.8 D^3$. The weight of the galena grains is above, and of the quartz below the values expressed by the equation $W = \frac{\pi D^3}{6} G$, which are 3.93 and 1.39 respectively. This is what we should expect, as galena tends to break into cubes and quartz into ellipsoids and lath-shaped pieces of all manner of irregular shapes, which, when sieved gently, have a weight, in proportion to their diameters, less than what spheres of quartz would have. The same is the case with pyrite grains, or crushed slag.

If, from these equations for the weights of quartz and galena grains, we should derive equations for the velocities of the grains falling in water we might claim to have the most accurate equations which could be derived from purely theoretical considerations. If $W = 1.15 D^3$ is the weight of the quartz grain in air its weight in water (W_w) would be:—

$W_w = 1.15 D^3 \frac{G-1}{G} = 0.716 D^3$. Equating the weight of the grain to the head of water impinging against its horizontal cross section we get:

$$0.716 D^3 = \frac{\pi}{4} D^3 \frac{V^2}{2g};$$

$$V = 133.6 \sqrt{D}$$

Similarly for galena we can derive the equation $V = 322 \sqrt{D}$ from the formula $W_g = 4.8 D^3$.

Factors Effecting Velocity of Falling Grain

Going further into the consideration of the factors acting when a grain is falling in water we see there are at least two more elements which enter. On the one hand, the weight of the grain in water is the only element forcing it down, so on the one side of the equation we may feel secure in placing W_w, or its equivalent 0.716 D^3 for quartz, and 4.16 D^3 for galena. On the other side there is the impact of the rising water against the horizontal section of the grain. This is an uncertain quantity. In fact it varies constantly as the grain revolves and twists while sinking. Here this section has been assumed a circle, which for the present seems as accurate as can be stated, although probably, as with the weight, the cleavage again enters.

Then, every grain is known to retain a film of water about it. This film may not be sharply defined, but the water immediately next to the grain stays with it; that not so close tends to stay with it, but may be dragged away; and the water outside of this may merely be dragged along for a short distance with the grain. The effect is that of a film of a definite thickness.

This action is well illustrated by beach sand. It is to be observed that beach sand does not wear down indefinitely, but after a certain fineness the grains are protected from further wear by a film of water. This film tends, in the case of grains sinking in water, to increase the diameter, and consequently the horizontal cross-section without increasing the weight. In the case of the larger sized

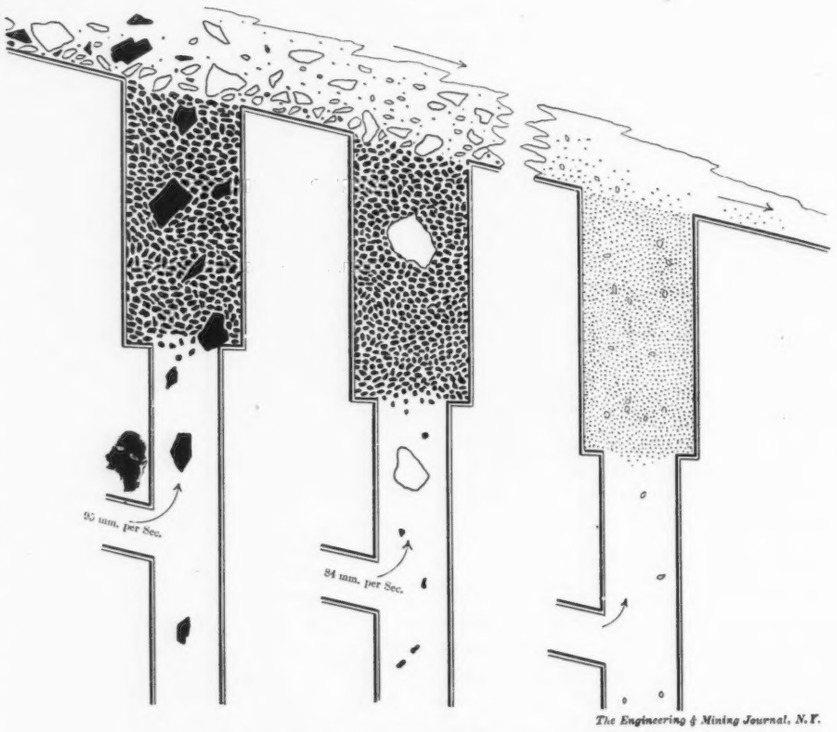

FIG. 3. APPARATUS FOR HINDERED SETTLING CLASSIFYING

grains this effect may be small, but in the case of the smaller ones it is an important factor.

Another influence seems to enter into the sinking ability of the finest grains. The water seems to have a power of cohesion which must be overcome by the grains. The smallest ones seem to be almost entirely unable to force the water apart. This is illustrated in the case of slimes which will hardly settle at all unless some water enters into account. There is a resistance offered by the water, which increases as the velocity of the grains increases. This effect acting on the larger grains, and the effect of cohesion, and a film adhering to the grain, acting on the smaller ones, is found to cause a nearly constant loss in velocity for all grains having a velocity above 5mm. per sec., according to the results obtained by Professor Richards.

$$V = \sqrt{\frac{W\,(G-1)}{D^2G}\frac{8g}{\pi}} - \left(0.1115\sqrt{\frac{W\,(G-1)}{D^2G}\frac{8g}{\pi}} \div D + 21.10\right) = 158\sqrt{\frac{W_w}{D^2}} - \left(17.6\sqrt{\frac{W_w}{D}} \div D + 21.10\right)$$

An attempt was made to derive formulas which should be more exact than these. The equations $V_q = 147\sqrt{D_q} - 55\sqrt[6]{D}$

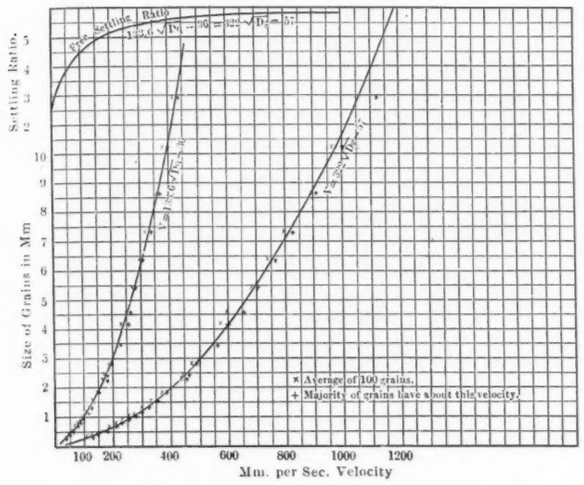
Free Settling Ratio
Size of Grains in Mm
Mm. per Sec. Velocity
× Average of 100 grains.
+ Majority of grains have about this velocity.

PLATE I. VELOCITIES OF QUARTZ AND GALENA GRAINS FALLING FREELY IN WATER

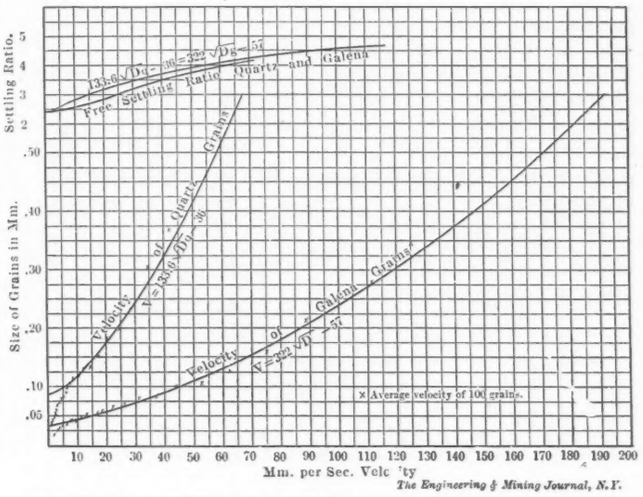
Free Settling Ratio Quartz and Galena
Size of Grains in Mm.
Mm. per Sec. Velocity
× Average velocity of 100 grains.
The Engineering & Mining Journal, N.Y.

PLATE II. VELOCITIES FOR GRAINS OF SMALLEST SIZE SHOWING DEVIATION FROM FORMULAS

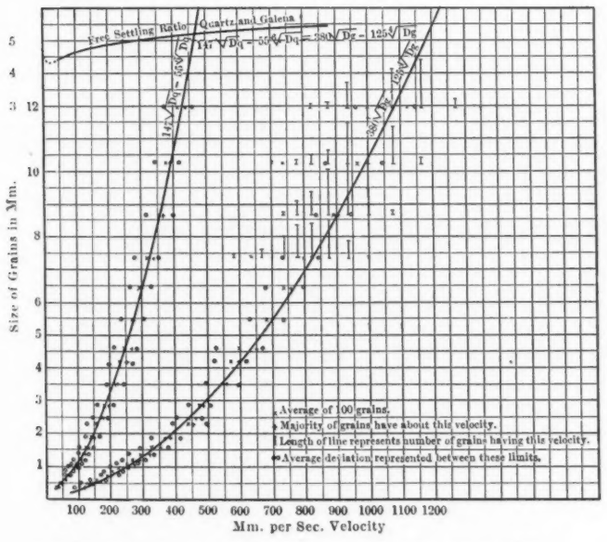
Free Settling Ratio Quartz and Galena
Size of Grains in Mm.
Mm. per Sec. Velocity
× Average of 100 grains.
+ Majority of grains have about this velocity.
Length of line represents number of grains having this velocity.
Average deviation represented between these limits.

PLATE III. VELOCITIES OF QUARTZ AND GALENA GRAINS FALLING FREELY IN WATER

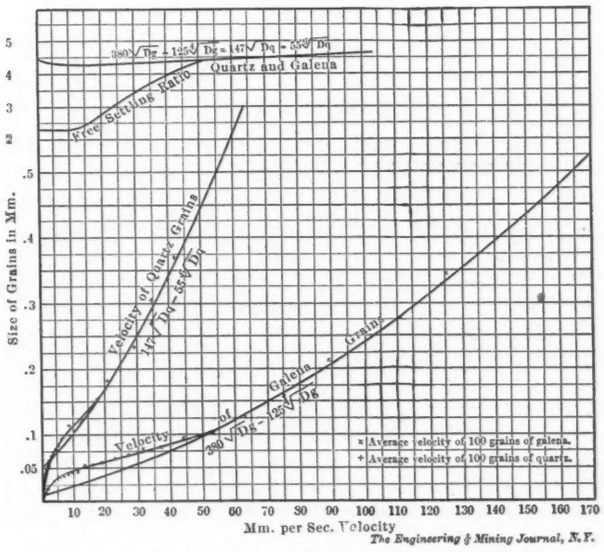
Free Settling Ratio
Quartz and Galena
Size of Grains in Mm.
Mm. per Sec. Velocity
× Average velocity of 100 grains of galena.
+ Average velocity of 100 grains of quartz.
The Engineering & Mining Journal, N.Y.

PLATE IV. VELOCITIES FOR GRAINS SMALLER THAN 0.5 MM. SHOWING DEVIATION FROM FORMULAS

salt, such as soda-alum, be added to the solution. This salt seems to destroy the water's power of cohesion. For example, grains of galena 0.03 mm. in size have the velocity which a grain of that weight and 0.5 mm. in size would have if it was merely a case of the weight acting against the impact of rising current. Grains of quartz 0.03 mm. in diameter have the velocities which would be expected of grains 1 mm. diameter and of that weight.

For the larger grains the viscosity of the

Equations Derived for Free-settling Velocity of Grains

Thus if we subtract 36 from the equation which we derived from quartz, and 57 from that for galena we get the equations: $V_q = 133.6\sqrt{D_q} - 36$ and $V_g = 322\sqrt{D_g} - 57$. As seen on Plates I and II these equations fit the results found from experiment admirably well. Generalizing these equations so as to have an equation to hold for all minerals we get: and $V_g = 380\sqrt{D_g} - 125\sqrt[4]{D_g}$ were found to be about the best empirical formulas which could be derived for the velocities of quartz and galena sinking in water. They are plotted on Plates III and IV and are seen to hold very well for all grains above 0.1 mm. diameter. The equation $V = 147\sqrt{D}$ is what would be derived, assuming the quartz grains to be spheres with no adhesion, cohesion, friction, etc., entering into consideration.

For the smallest grains both of the

above sets of formulas fail, and we must use the formulas $V = 700\ D^2$ for quartz, and $V = 4000\ D^2$ for galena.

For grains of quartz and galena having equal settling velocities the equations may be combined thus:

$$133.6\ \sqrt{D_q} - 36 = 322\ \sqrt{D_g} - 57.$$

Substituting values for D_g we get corresponding values for D_q. D_qD_g is the free-settling ratio of quartz and galena. This ratio is plotted on Plates I and II. In the case of the smaller grains, Plate II also gives the ratio as computed from the plotted values, thus showing the variance of the actual ratio from that derived from the formulas. Plates III and IV show the same as Plates I and II using the more exact formulas.

In the case of the smallest grains the ratio figures out

$$700\ D_q^2 = 4000\ D_g^2;\ D_q^2 = \frac{4000}{700}\ D_g^2 = 5.71\ D_g^2;$$

$$D_q = 2.39\ D_g;\ \frac{D_q}{D_g} = 2.39 = R.$$

The free-settling ratio for the smallest grains seems to be a constant, i. e., 2.4.

Hindered Settling

In Fig. 1 is represented, diagrammatically, a tube having a constriction at the lower end. The area of this constricted end is about one-quarter the area of the cross section of the rest of the tube. A current of water runs from the bottom and overflows over the top. A mixture of crushed quartz and galena, for example, below, say, 2 mm. diameter, has been put into the tube. The velocity of the current rising through the constricted area of the tube is such that the heaviest grains just cannot fall through it. From Plate I or Plate III we see that this velocity, since the largest galena grains are 2 mm. diameter, must be 400 mm. per second.

In the tube the larger and heavier grains find their way to the bottom, the lighter ones are forced up. A state of equilibrium is reached where the actual velocity rising through any section of the tube is just sufficient to support the grains which are occupying that section. Thus we notice that toward the bottom of the column the grains are more compact than higher up. Perhaps the condition of the grains near the bottom could be described by the term, "just not teeter;" those a little higher up "just teeter;" and still higher as "full teeter," whereas the grains at the top of the tube would be so widely separated from one another as to be called "free-settling."

The point to be noticed in this condition is that the grains of quartz which find their place at a certain hight of the tube are of such a size that their free-settling velocity is very much greater than that of the galena grains which occupy the same position in the tube, when the system is in equilibrium. It might be supposed that grains having the same settling velocities would occupy the same portion of the tube. Such is not the case, and it is in this action that hindered-settling obeys different laws from free-settling. The larger grains of the lighter mineral are forced up by the smaller grains of the heavier mineral.

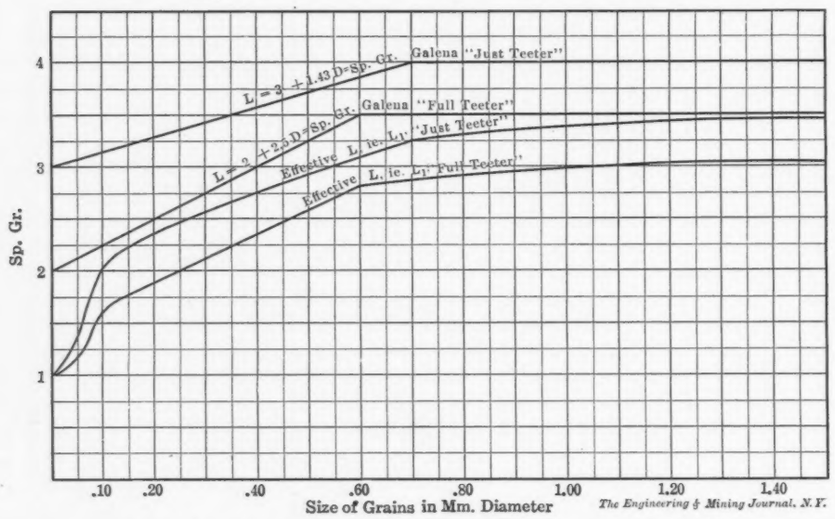
Galena "Just Teeter"
Galena "Full Teeter"
Effective L, ie. L1, "Just Teeter"
Effective L, ie. L1, "Full Teeter"
Sp. Gr.
Size of Grains in Mm. Diameter
The Engineering & Mining Journal, N.Y.

PLATE VI. SPECIFIC GRAVITIES AND EFFECTIVE SPECIFIC GRAVITIES FOR COLUMNS OF TEETERING GALENA

The effect of maintaining a column of teetering grains is that of establishing a liquid whose specific gravity is equal to the total specific gravity of this teetering column, with modifications which will be considered below, and whose viscosity is that of water, as it is a case of the current rising against the grain which is trying to sink through it, rather than that of the grain falling freely through a quiet liquid.

Experiments carried out especially for this paper give data as shown on Plate VI. If a column of teetering grains of galena is maintained so that each grain seems to be supported freely by the current, and not at all resting on any grains below it, we have a state which is here called, full teeter. For grains below 0.6 mm. diameter the specific gravity of such teetering columns, which is symbolized as L, varies directly from 2 to 3.5 as the diameter of the grain increases. Therefore $L = 2 + 2.5\ D$. For teetering columns of grains larger than 0.6 mm. the specific gravity, under these conditions, is 3.5. The increase in specific gravity of the teetering column due to the galena thus varies from 1 to 2.5.

For purposes of hindered-settling it does not seem necessary to keep the grains so actively teetering. If they can be kept at just enough of a teeter so that any large grain can readily find its way through the column we have the state of highest efficiency of the teetering column, for then it has the highest possible specific gravity, and yet is capable of doing its work, which is, in part, to allow all grains of a higher hindered-settling velocity than those of which it is composed, to pass through. This condition is called, just teeter. For lack of time this state was not thoroughly tried out. Further experiment may show that a still higher specific gravity may be maintained in the teetering column, without destroying its efficiency. The condition of just teeter seems to have a specific gravity varying from 3 to 4 as the grains vary from 0 to 0.70 mm., in $L = 3 + 1.43\ D$. For larger grains the specific gravity remains at 4.

The effect of the increase in the specific gravity of the teetering column, due to the galena in it, is diminished by the fact that the velocity of these grains is less than their theoretical velocity. If their actual velocity is only a half of their theoretical, the increased specific gravity due to their presence will be only half available.

Let us imagine a tube containing granulated iron suspended in water. If it were possible, imagine a magnet held above this column at just such a position that the grains have no tendency to sink. In this case would the presence of the iron in the water have any power to force a grain of quartz, for example, up? Certainly not. Any non-magnetic substance which could sink in water could sink with the iron present. If, however, the magnet were removed, and a current of water passed up through the tube, just sufficient to keep the iron in suspension, it would be found that grains of quartz which might be able to sink through this current of water were the iron not present are now unable to penetrate this bed of teetering grains, and if they should get into it, would be forced up again.

In the case of galena, or any other mineral, there is an action similar to that of the imaginary magnet, which keeps the grains from sinking as rapidly as we might expect. This action is the combination of all the forces described above as adhesion, cohesion, internal friction, etc. The power of the grain of galena to force up the larger grain of quartz is measured

by its ability to sink. Thus the increase in the specific gravity of the teetering column due to the presence of teetering grains is not wholly available for keeping other grains from settling. The available increase of specific gravity is proportional to the available velocity of the grains forming the teetering column. By the available velocity of a grain is meant the actual velocity in contrast to the theoretical velocity. On Plate V is shown what per cent. the available velocities of quartz and galena grains are to their theoretical velocities. It is seen that the actual velocities range from practically nothing for the smallest grains to 83 per cent. for the largest galena grains plotted there.

If these percentages be applied to the equations for the specific gravity of teetering columns as plotted on Plate VI, we get the other curves which show the effective specific gravities of these teetering columns under the conditions of "full teeter and just teeter.

Equations for Hindered Settling

The general equation for the free-settling velocity of any mineral has been found. For hindered-settling the only difference is that the specific gravity of the liquid, through which the grains are to fall, has been increased. Instead of its being unity it has become L_1, which varies with the size of the grains forming the teetering column, and with the condition of teeter used, as plotted on Plate VI. Thus we may write the general hindered-settling equation:

$$V=\sqrt{\frac{W\,(G-L_1)\,8g}{D^2G\,\pi}}-\left(0.1115\sqrt{\frac{W\,(G-L_1)\,8g}{D^3G\,\pi}}\div D+21.1\right)$$

or calling the term

$$\sqrt{\frac{W\,(G-L_1)\,8g}{D^3G\,\pi}}\div D,\ a;$$

$$V=158\sqrt{\frac{W\,(G-L_1)}{D^2G}}-(0.1115a+21.1).$$

For quartz, where $W=1.15D^3$, the equation becomes:

$$V=104\sqrt{(G-L_1)D_q}-(0.1115a+21.1),$$

a being $104\sqrt{G-L_1}$.

Consider the case of quartz and galena. For any value of V we find the corresponding size of the galena grain having that free-settling velocity, or *vice versa*. Thus where quartz is the lighter mineral the equation for hindered settling becomes:

$$V=104\sqrt{(G-L_1)\,D_q}-(0.1115\times 104\sqrt{G-L_1}+21.1).$$

From the size of the galena grain and the condition of teetering we wish to consider, we find the corresponding value of L_1 from Plate VI. All the terms of the above equation are now known except D_q. By solving the equation we get D_q corresponding to V and D_g from which we can plot the hindered-settling velocities of quartz and galena corresponding to the conditions of teeter, as done in Plate VII.

In finding the specific gravity of a mixture of water and a mineral we can use the formula $L=(G-1)P+1$, where P is the proportion of the mixture occupied by the mineral. In the case of galena this becomes $L=6.5\,P+1$. For the condition of full teeter we have found that for grains under 0.6 mm. $L=2+2.5\,D$, therefore $2+2.5\,D=6.5\,P+1$; $P=\frac{1+2.5\,D}{6.5}$. Likewise for the condition of just teeter in the case of grains under 0.7 mm. $P=\frac{2+1.43\,D}{6.5}$. If P_w represents the proportion of the mixture occupied by water $P+P_w=1$, or $P_w=1-P$.

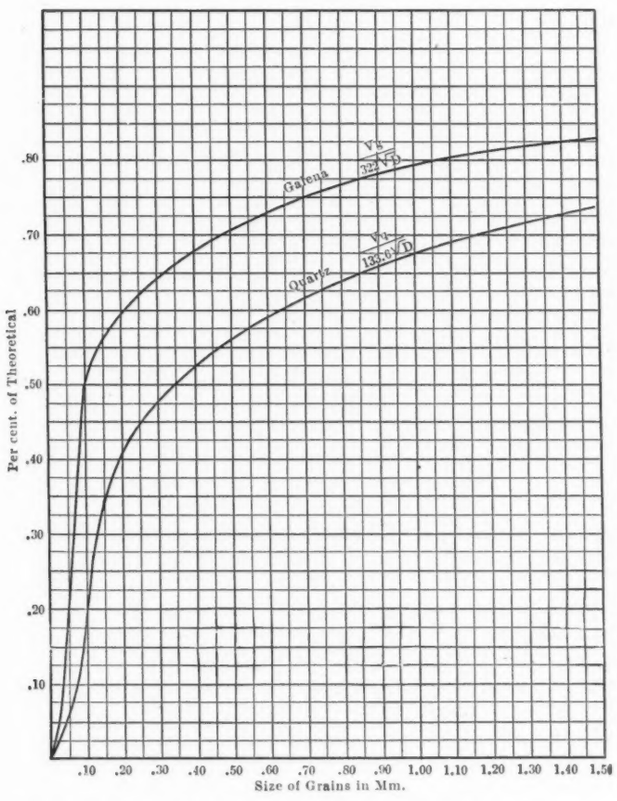

PLATE V. PER CENT. OF THEORETICAL VELOCITY ATTAINED BY GRAINS FALLING FREELY IN WATER

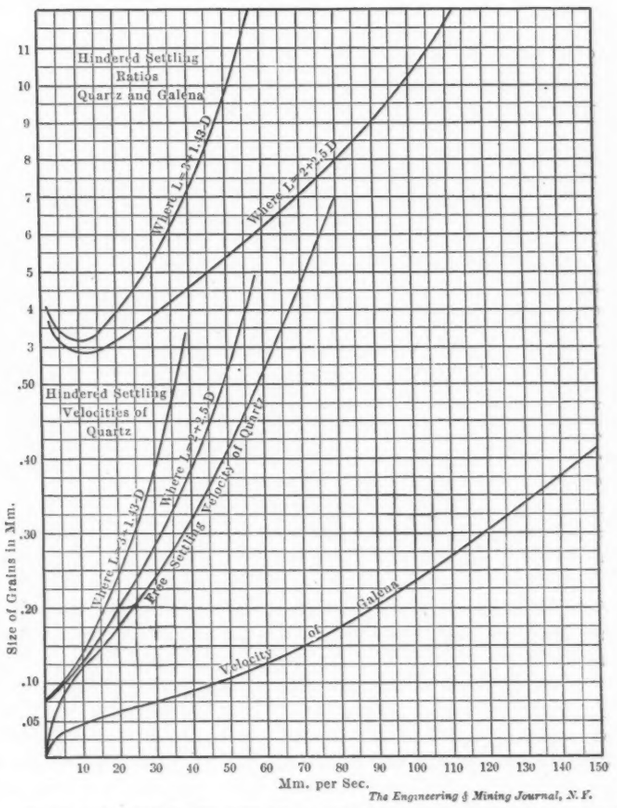
Hindered Settling Ratios Quartz and Galena
Hindered Settling Velocities of Quartz
Free Settling Velocity of Quartz
Velocity of Galena
Size of Grains in Mm.
Mm. per Sec.
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
The Engineering & Mining Journal, N.Y.

PLATE VII. HINDERED SETTLING RATIOS FOR QUARTZ AND GALENA AND SETTLING VELOCITIES

Application to Classification

To figure the ratio of the size of the constriction to that of the tube containing the teetering column so that the velocity of water in both cases would be the same, let us call A the area of cross-section of the tube containing the teetering column and C that of the constriction. Then

$$\frac{C}{A}=P_w.$$

Here again we find that the practical and the theoretical conditions do not match, so we must consider the working conditions. Fig. 2 represents a vertical section of a teetering column. The galena

grains are represented in solid black. The areas cross-hatched represent water which is practically still. The unshaded spaces between the grains represent the portion of the water which is moving. From experiments it is found that in the case of full teeter, about half of the water has the effect of being still. For larger grains it is slightly more than half and for smaller ones less, but for practical purposes we may consider half of the water as moving and half as still for all size grains. Under this consideration our formula becomes $\frac{C}{A} = \frac{P_w}{2} = \frac{1 - P}{2} = \frac{6.5 - 1 - 2.5\,D}{13} = \frac{5.5 - 2.5\,D}{13} = 0.423 - 0.192\,D$, where the teetering galena grains are below 0.6 mm. Where they are above that $L = 3.5$; $P = \frac{2.5}{6.5}$; $\frac{C}{A} = \frac{1 - P}{2} = \frac{6.5 - 2.5}{6.5 \times 2} = 0.308$. In the case of just teeter the active water is more nearly a third of all the water and the ratio works out

$$\frac{C}{A} = \frac{1 - P}{3} = \frac{6.5 - 2 - 1.43\,D}{6.5 \times 3} = \frac{4.5 - 1.43\,D}{19.5} = 0.231 - 0.073\,D.$$

Hindered Settling Classifying

From the equations for the ratio of size of constriction to that of teetering column it is seen that to maintain a given condition, such as full teeter, the apparatus used for every size grain must be different. The smaller the grain the smaller must be the ratio C to A, in the apparatus. If a tube, as in Fig. 1, is used and the current cut off by degrees we will have grains of galena and quartz coming down together which have the same hindered-settling ratios, but each time the condition of teeter will be different. If the ratio of size of constriction to teetering column is such that the larger grains are in a state of full teeter when the current is just enough so they cannot fall through the constriction, then by the time the smaller grains begin to come down a state of less teeter is maintained. The grains are not at full teeter, thus the specific gravity of the column is increased above what it would be if they were, and we are approaching the state of just teeter. Experiments carried out with such an apparatus have thus been known to give, within narrow limits, a higher hindered-settling ratio for the smaller grains than for the larger ones.

It may be difficult to change the ratio of size of constriction to size of teetering column as the size of grains changes, so an apparatus designed on the principle of Professor Richard's hindered-settling classifier may be of interest as it can be made to regulate this difficulty automatically. As shown in Fig. 3, there are a series of tubes through which a diminishing series of currents are rising. The currents are so regulated that the first tube will maintain a bed of galena of a desired size. The other tubes maintain beds of galena of decreasing size. In this way each tube is made of such a size, in proportion to that of the constriction, that the desired condition of teetering is maintained.

Suppose we are treating a product of galena and quartz below 2 mm. diameter, and decide to maintain the condition of full teeter, (this condition is higher than desirable in practice). We wish to get only galena in the first product. From Plate VII we see that if we use a current of 95 mm. per sec. in the constriction we will maintain a column of galena 0.22 mm. diameter and that the quartz which has an equal settling velocity with this is 9.6 times as large, i.e., is 2.11 mm. diameter. The ratio of cross-section of constriction to the upper tube is

$$0.423 - 0.192 \times 0.22 = 0.381,$$

and the ratio of their diameters is

$$\sqrt{0.381} = 0.617.$$

In the second tube we wish to catch all quartz above 1.6 mm., for example. If we use a current in the constriction of 84 mm. per sec. we see from Plate VII that a column of galena 0.19 mm. in diameter will be maintained and quartz 8.4 times as large, or 1.60 mm. will have an equal settling velocity. Thus we will catch here quartz between 1.60 and 2 mm. and galena between 0.19 and 0.22 mm. The ratio of area of constriction to that of the upper tube is again figured to be $0.423 - 0.192 \times 0.19 = 0.387$ and the ratio of their diameters

$$\sqrt{0.387} = 0.623.$$

The same method of calculation can be applied to each tube.

In practice it may be well to have velocities slightly above those calculated, and the ratio C to A slightly larger because of the imperfect action of the teetering grains. By reason of their odd shapes they are constantly bobbing up and down. Unless this precaution is taken a grain at the bottom of the teetering column which, because of this bobbing effect, is moving down, is met by a rising current only sufficient to support it. The downward momentum of the grain may be enough to carry it through the constriction and it will be found that the size of the grains finally left in the teetering column is slightly below what we calculated on. The longer the constriction the less will this effect enter in.

The object in hindered-settling is to effect a higher ratio in the sizes of the grains of the heavier and the lighter minerals than can be done by simple free-settling. This is accomplished by establishing a teetering column of the heavier mineral, which acts toward the lighter mineral as though it were a liquid of greater specific gravity than water, and at the same time allows the heavier mineral to act under free-settling conditions.

The efficiency of the system depends on how high an effective specific gravity can be maintained in the teetering column. This can be done by keeping as low a state of teeter as the efficient working of the apparatus will stand; and then by bringing the effective specific gravity of the column up as near as possible to the actual. This latter state can be helped by using for the teetering grains those approaching spheres; for spheres, having the same cross-section for all positions, can be made to teeter quietly, thus keeping the teetering column of even texture. Odd shaped grains, having widely differing cross-sections, depending on the position they are in, will be either rising or sinking all the time. This constant movement of the grain spoils the effect of the column. It can be largely overcome, however, by lengthening the column. In a system as shown in Fig. 3 this difficulty soon remedies itself, for the more spherical grains will by degrees take the place of the odd-shaped ones, and in time the teetering column will be composed of all the most spherical grains of the size which just cannot sink in the constriction.

Where galena is to be separated in practice from a gangue it would greatly increase the efficiency of a hindered-settling classifier if columns of granulated lead were first established by running a lot of it through the system. In this way the specific gravity of the teetering columns would be increased, and the spheres of lead could be depended on to teeter much more uniformly than the odd-shaped grains of galena which might happen to form the columns.

In the case of the finest grains the effective specific gravity of the columns can be increased by increasing the actual, as related to the theoretical, velocities of the grains. This can be done by using water charged with a salt, such as soda-alum, which, by breaking down the cohesion of the water, will allow these small grains to have a higher settling velocity.

Before a hindered-settling classifier, or other such apparatus, can be relied upon to give best results a thorough understanding of the laws of hindered-settling must be had and applied to the apparatus. Once this is done the hindered-settling apparatus is destined to supersede, in certain classes of work, the free-settling one; especially where fine results are desired, or minerals of nearly the same specific gravity are to be separated.

By following the procedure given above for galena and quartz, a typical ore and gangue, similar results can be worked out for any minerals; the only data required being an equation for the weight of the grains of the minerals in question in respect to their diameters. As yet not enough experimental work has been carried out to warrant any claim as to the ultimate accuracy of all the equations

given. Yet, I feel that they cannot be far from correct, especially as they correspond, to a resaonable degree, with results obtained in such experimental work as has been performed up to the present time.

An Urgent Pumping Problem and How It Was Solved

By James A. Seager*

The breaking out of water during mining and sinking operations is, unfortunately, a contingency that has always to be reckoned with, and sinking pumps have been devised to meet such demands. Occasionally, however, these outbreaks come upon the engineer unexpectedly and require prompt handling if delay and expense are to be avoided. On such occasions the ingenuity of the officials in utilizing the materials at hand and adapting them to circumstances, is frequently the means of saving the situation and avoiding the complete stoppage of work. The following is a description of a pumping problem of this character and its successful treatment.

Sudden Flow of Water

In Fig. 1, is a shaft which was originally used for ventilating a part of a mine through the drive *m*. At a later date it was decided to sink the shaft past *m* to another seam, and sinking operations were proceeding at *s* when a feeder broke through just below *m*. This, together with the usual intake of water above *m*, was too much for the small pump then in use and the shaft was found to be quickly filling.

As the flooding of the drive *m* involved the stoppage of another mine in addition to damage to roads and plant, the water was held partly by constant winding with the barrel *b*, and partly with the small pump previously working. As, however, this latter was in bad condition and in constant danger of breakdown, it was necessary to make arrangements to get a larger pump to work as quickly as possible.

There was available a 3-throw horizontal electric pump purchased for another mine but not at the time put to work, and, as the colliery was somewhat inaccessible and the pump makers would not guarantee delivery of a new pump in less than three weeks, it was decided to alter this horizontal pump for vertical working and to sling it in the pit.

The valve boxes were removed and a fitter was instructed to alter them for vertical working. At the same time the bedplate was strengthened by means of a steel frame *f*, Fig. 2, made up of joists and channels, so that the whole arrangement could be conveniently suspended by a rope. The motor end-plates were also removed and turned through an angle of 90 deg. so that the oil wells should be vertical in their new position, and the pump bearings, which were not capable of this treatment, were instead fitted with spring grease lubricators. A wooden shed was also fitted over the sling chains as shown to keep the motor dry.

Motor to be Started from Surface

A difficulty arose at this stage of the work as to the starting of the motor. This was a 25-horsepower 3-phase machine with wound rotor and requiring a starting resistance in the rotor circuit. A starting resistance could have been placed at *m*, but there were several reasons why the motor should be started from the surface. Among other reasons the management strongly objected to any more cables being slung in the pit than were absolutely necessary.

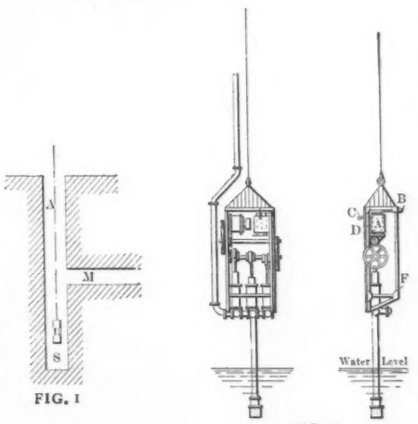

FIG. 1

FIG. 2

The Engineering & Mining Journal, N.Y.

ARRANGEMENT OF PUMP

Now, if the slip rings were shortcircuited, the motor would run perfectly when once started, but with this type of winding it would start only when the rotor was in certain positions. It was necessary, therefore, to have some resistance in the rotor circuit to insure its starting in any position when switched on the surface.

This was done by means of the liquid resistance *a* (Fig. 2), fixed on the pump itself. *A* is an iron tank fitted with 3 wrought-iron plates, each having an area of 2 sq.ft. and rigidly supported from the top by porcelain insulators. These electrodes were connected by short pieces of cable to their respective slip rings on the motors corresponding to the three phases of the windings. A small watertrough was then fixed round the base of the wooden shed and a small pipe *b* was fixed to lead the water which fell upon the shed into the tank *a*. This insured that water would be continually flowing into the tank.

The next step was to lead the water out of the tank at such a hight there would be just sufficient area of the plates covered to give a resistance at which the motor would start, and, at the same time, not too much resistance to slow the motor speed much below its ordinary running speed. The level of water required to start the motor against full load was found by experiment and an overflow pipe *c* was then tapped into the box at this hight.

In this case there was ample water falling upon the shed to keep the tank cool, but much the same result could have been obtained by taking the supply *b* from the rising main. Moreover, with a 25-horsepower motor, supplied from a large generating plant, there would be no excessive voltage drops when the motor was switched on, but the motor could be started slowly by fixing an additional pipe *d* at a lower level and fitting in it a simple valve controlled by a solenoid. The solenoid would be energized when current was switched on and would close its valve. The tank would then fill gradually until it reached the overflow point. Also the pipe *c* could be fixed on the surface at a lower level, and, with the pump in position, could later be bent upward until the correct overflow was found. These points may be of interest to an engineer who may have occasion to adapt the above idea to his own requirements.

The supply from the surface was a 3-core simple wire-armored cable supported at intervals by clamps on the rope, and the current was first switched on through an auto-starter giving about 65 per cent. of the full voltage on the starting side. This auto-starter was not big enough for a 25-h.p. machine and it was afterward discarded, the full voltage being switched direct to the machine. The pump ran perfectly for some months until the sinking operations were completed and it was then reconverted for working in its original horizontal position and permanently fixed at the shaft bottom.

At Central City, in Gilpin county, Col., the Rocky Mountain National Bank reports that it has shipped gold bullion to the Denver mint since Jan. 1, 1909, amounting to $12,000 more than was shipped during the whole of the year 1908. The Penobscot tunnel, in the same county, is now in 1000 ft., and if continued will cut the Perigo vein 500 ft. below the adit level, above which to the surface (600 ft.) has been extracted gold ore of a gross value of $3,000,000. The experience of other Gilpin county mines down to as deep as 2300 ft. indicates that favorable results may be expected.

A miners' right for South Africa costs 5s. It is in force for one year from date of issue.

*Civil engineer, Blackett street, Newcastle-on-Tyne, Eng.

Novel Spoil Transporter for Stripping Operations

Handles All Sorts of Material without Clogging; Capacity 500 Cubic Yards per Hour; Power Requirements Low; Distributes Material Evenly

BY FRED A. TALBOT*

A new and novel type of transporter has been devised by A. R. Grossmith, of Kettering, Northamptonshire, England. The machine was evolved in order to cope with the peculiar conditions prevailing in iron-ore beds of Northamptonshire, where a thick layer of top soil, or callow, has to be removed in order to expose the ore-beds. In removing this callow it was necessary that it should be redumped behind the machine in such a manner that the land covered with the spoil could be used for agricultural purposes. In order to accomplish this it was essential that the waste should be distributed evenly. With the ordinary types of traveling belt or tray conveyers fed from a steam excavator this was not possible. Moreover, although possessing a certain amount of transporting efficiency, the tray type is of low capacity, and the belt conveyer, while superior in this respect, is expensive to install and maintain.

SIDE VIEW OF APPARATUS TAKEN DURING ERECTION

TOP VIEW SHOWING RIM AND CHARGING HOPPER

At the Corby iron works experience showed that the best results in the removal of the callow were formerly obtainable by manual labor, the spoil being dumped into wheelbarrows and wheeled across temporary laid planks to the opposite side of the cut where it was discharged and leveled off as work proceeded. This, though slow, insured the bottom of the cut being kept quite open for the passage of railroad cars receiving the loads of ore.

Construction of the Conveyer

In order to expedite this operation, Mr. Grossmith devised the type of rotary conveyer shown in the accompanying illustrations. The first machine was constructed and erected at the Corby iron works nearly three years ago. It comprises a wheel 80 ft. in diameter, erected horizontally, but capable of inclination as desired. This wheel is fitted around its periphery with an annular table 42 in. wide, secured to the upper edge of the vertical rim of the wheel, and stayed on its under side at regular intervals with diagonal steel bracing so as to insure its absolute rigidity. The table is built up of ⅜-in. steel plates.

The rim, which is also built up of ⅜-in. steel plate, is entirely supported by two hundred and twenty-four 5/16-in. steel wire spokes radiating from a hub built of light steel work, 112 spokes stretching tangent fashion from the upper and lower extremities of the hub, respectively. The spokes are secured to the rim by means of ½-in. eye-bolts and the wheel can always be maintained in a perfectly taut condition. The inner edge of the rim is surmounted by a 2x2-in. T-bar with which the discharging apparatus engages as will be described later. The hub is mounted upon roller bearings on a small platform, which in turn is carried on the end of a cantilever arm. The wheel, however, is completely free, its only support being the central hub, and without any roller bearing on the outer end of the cantilever arm to take the weight of the load as the conveyer is charged from the hopper, which is also carried on the outer extremity of the cantilever beam. This insures the wheel being extremely flexible. The wheel, together with its hub and platform, weighs about 7 tons, but so perfectly is it balanced that without load it can be easily rotated in either direction by hand. Around the lower face of the vertical rim is placed a small groove which carries a 1½-in. cotton rope by which the necessary drive is furnished from the mechanism housed below the conveyer.

The cantilever arm is carried on trunnions which enable the beam to be inclined to any angle, according to the working position of the steam excavator, and so permit the passage of railroad cars along the track beneath the apparatus. The superstructure is mounted on a pedestal frame carried on a turntable on the deck of the wheeled trolley, by which the conveyer is propelled backward and forward along its track. This arrangement is a distinct advantage since it enables the machine to be brought to work in a narrow cut and to stand obliquely to the cutting irrespective of its direction of travel without impairing its efficiency in any way. In the pedestal mounting are housed the steam boiler and requisite mechanism for operating the wheel conveyer, loading hopper, the inclination of the cantilever beam, the revolution of the whole upon its turntable, and also, through clutches, the forward and backward propulsion of the appliance along its track in the cut.

The Loading Hopper

The loading hopper possesses some novel features. It is mounted on a pivot at the outer extremity of the cantilever arm and is revolved through bevel gearing and rope drive from the pedestal engine house. It is of circular form and comprises a disk of ⅝-in. mild-steel plate 8 ft. in diameter. It is entirely surrounded, except at the point where it comes opposite to the main conveyer

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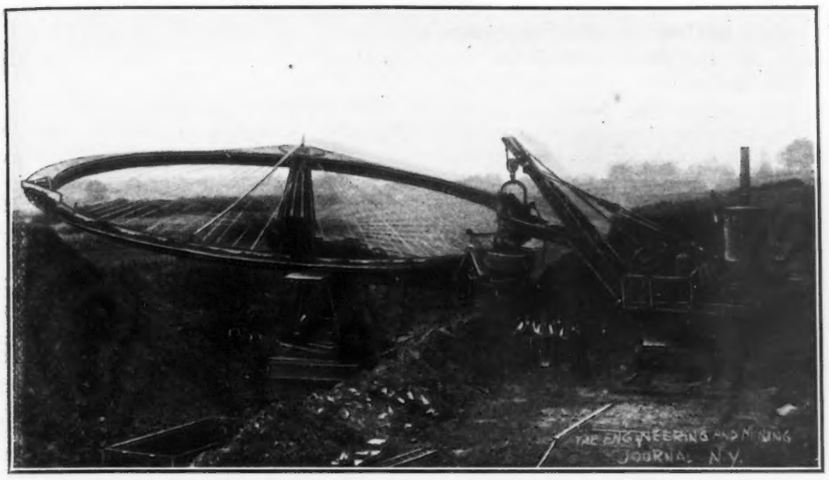
wheel, by a rim 2 ft. high, built up of ½-in. steel plate, disposed vertically and held firmly in position by means of substantial brackets secured to the cantilever arm. Around the axis of this plate is disposed another circular ring 3 ft. 6 in. in diameter and 4 in. in hight. This ring is inserted merely to take the pressure or thrust of the plow or scraper by means of which the earth dumped into the hopper is shot onto the revolving conveyer wheel. This plow is a section of steel plate 6 in. in hight, the outer extremity of which is fixed to the end of the stationary wall of the hopper, and is placed across the space between that and the inner circular thrust ring at an easy angle.

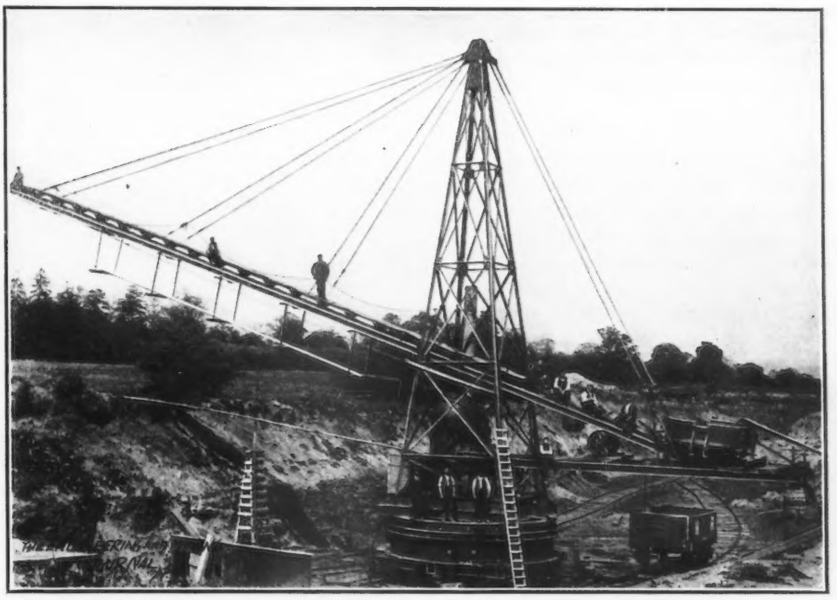


CONVEYER AT WORK SHOWING HOPPER CHARGED FROM STEAM SHOVEL

The spoil is dumped into the hopper from the bucket of the steam shovel and is carried around by the revolving base-plate until it comes into contact with the obstructing plow which deflects it through the opening in the hopper wall onto the rotating conveyer wheel. Should a greater volume of material collect at the opening than the conveyer is capable of handling, the excess passes over the top of the plow and is carried around again and then shot through the discharge opening.

Experience with this hopper has demonstrated its many advantages. In the first place it is capable of dealing efficiently with any description of material, whether loose fine sand or lumpy sticky clay, with equal success. In fact, the absence of clogging or blocking, no matter what is the character of the material handled, is one of its chief advantages. It also takes the full shock of the dump from the steam shovel so that no vibration is transmitted to the main wheel conveyer. This system also insures a steady feed from the hopper to the conveyer. The machine requires no cleaning by hand as this can be effected merely by centrifugal force.

Owing to the success that has attended the utilization of this hopper with the rotary conveyer, it was fitted to a rubber band conveyer to ascertain its capability with such a system. The results were completely successful. The conveyer was 100 ft. in length, fitted with a 30-in. belt, and the hopper was found capable of dealing with the maximum output of an American steam shovel of the Robinson class (38x16x2½) with ease. The only difficulty experienced was in connection with the conveyer itself, for the belt gave considerable trouble in dealing with the large masses of wet clay which broke the idlers or pitched overboard in transit owing to the jolting of the idlers. In the case of the rotary wheel conveyer no such difficulties are experienced. There is nothing to disturb the load, as the shock of the shovel dump is entirely taken up by the hopper and no rolling off the revolving table is experienced until an angle exceeding one in four is reached. Moreover it is easily capable of handling masses of sticky material aggregating half a ton or so in weight.



PATENT HOPPER ATTACHED TO BAND CONVEYER

Discharging Apparatus

At the point where it is desired to dump the spoil another plow is placed. This comprises an angular framework mounted on horizontal and vertical rollers. The former engage with the T-bar of the rim while the latter travel upon the moving surface of the annular table to minimize friction to the utmost. The plow is built up of 5/16-in. steel plate and is 12 in. in hight, being disposed vertically, and set at an easy angle across the transverse section of the revolving table. The point of the plow holds itself in position against the rim T-bar, while the opposite end stretches across to the outer edge of the wheel, being held there by one member of the plow framing mounted on a horizontal wheel which takes up the back thrust.

The wheel in revolving brings round the material with which it is laden until it reaches this plow, when the débris is deflected off the table and falls in a steady stream onto the dump heap. The plow can be set at any point of the wheel even well beyond a point opposite the hopper, that is, in excess of 180 deg., and adjustment can be effected while the wheel is revolving with its load. This is effected in a simple manner. Disposed around the rim of the wheel are a number of carriages, which may be multiplied as desired. These carriages are fitted with hardened rollers which engage with the rim T-bar. Each carriage has a pulley over which passes a ⅜-in. cotton or steel-wire cord one end of which is attached to the point of the discharge plow and the other leading to the driving station around the wheel rim in a series of short tangents so that there is no fouling of the

spokes. By paying out the cord or pulling it in the plow can be set to any position on the traveling table. The result is that, in dumping, the spoil is distributed uniformly over the dump heap so that when it is required to reclaim the land no preliminary leveling is necessary. Owing to the method of mounting the discharge plow, wear and frictional resistance are reduced to a minimum. In fact after about six months' continuous handling of from 400 to 500 yd. of sandy material per day one of these conveyers still retained noticeable bloom on the table plates.

Manipulation and Capacity of Machine

The transporter can always travel level with the excavator, along its track through the cut. When the end of the travel is reached it is only necessary to reverse the rotating direction of the wheel conveyer and reset the plow (a matter of a few seconds) to meet the opposite direction and the return journey through the cut can be made to the opposite limit of travel. As the steam shovel eats into the bank the machine can be moved laterally to keep the hopper within the acting range of the steam shovel.

These conveyers have not been tested to their full capacity as yet, but that they are capable of dealing with a greater volume of material than can be dug by any ordinary type of shovel has been proved. Their designed handling capacity is 112 lb. per lineal foot of table and as a speed of 6 r.p.m. can be attained without the load being influenced by the centrifugal force, this gives a practical capacity of about 500 cu.yd. of material per hour. The power necessary to drive the apparatus is small, a small boiler and low-power steam engine being all that is required.

These machines are well adapted for use in mining areas far removed from civilization as they are easily erected and repairs amount to little. For instance one of these machines was built *in situ* by agricultural laborers under the supervision of the inventor and with no other tools than are usually found in ordinary repair shops. The wheel was built, launched into position along the cantilever arm and joined up. Maintenance expenses are reduced to the minimum, the only outlay on repair incurred on the machine in use at Corby during its 2½ years' work being $10. Owing to the success that has attended the use of a conveying wheel 80 ft. in diameter, arrangements are now being made for the erection of a 120-ft. one to meet the requirements of special conditions under which it is to be used.

The total number of men employed in mining and mineral works in South Australia on Dec. 31, 1908, was 6350. Of this number 4470 were working in copper mines and works.

Condensation in Steam Pipes*

In the accompanying chart the radiation loss has been taken as 2.75 B.t.u. per square foot of heating surface of bare pipe per hour for each Fahrenheit degree of difference between the temperature of the steam in the pipe and that of the air outside it. This figure is probably a minimum; it particularly refers to pressures of less than 100 lb. and has been arrived at after carefully considering available data. A steam gage pressure of 100 lb. and an average air temperature of 77 deg. F. have been taken.

The equivalent condensation per square foot of bare pipe per hour = 0.82 lb. of steam arrived at as follows: Steam gage pressure, 100 lb. per sq.in.; temperature of steam at above pressure, 338 deg. F.; average temperature of air, 77 deg. F.; difference, 261 deg. F.; loss per square foot per hour = 261 × 2.75 = 717 B.t.u.

To change one pound of water at a temperature of 338 deg. F. into steam at 338 deg. F. requires 877 B.t.u. Therefore, the loss by condensation per square foot of bare pipe per hour is $\frac{717}{877} = 0.82$ lb. This result forms the basis for constructing the full line plottings in the chart.

With asbestos-covered steam pipes the loss by condensation may be taken as one-fourth that of a similar uncovered surface, and with this as a basis the dotted line plottings have been made.

By taking any of the sizes of steam pipe shown and following the ordinates for length to the corresponding abscissas for pounds of steam lost per hour, the difference in loss between bare and asbestos-covered piping is seen. The plottings can be taken only as approximate, but should serve to indicate in any particular line of steam piping, whether a closer investigation would be justified.

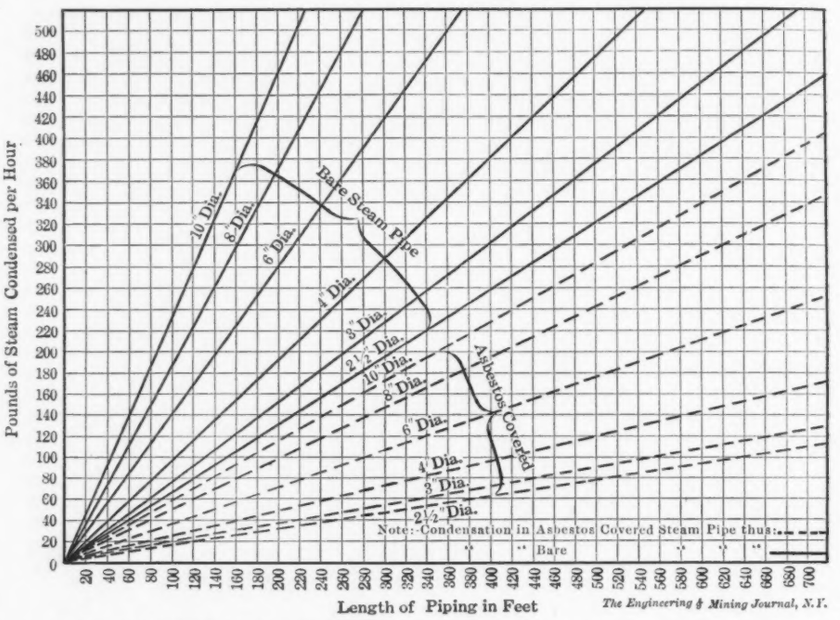


CHART FOR CALCULATING DIFFERENCE IN LOSS BETWEEN BARE AND ASBESTOS-COVERED PIPE

*Abstract of an article by W. R. Degenhardt in the *Monthly Journ.* of the Chamber of Mines of Western Australia, June 30, 1909.

The Malheur Oilfields of Oregon

Special Correspondence

The Malheur oilfields are being developed as rapidly as machinery will put down the wells. At the present time there are five companies at work. The Mammoth Oil and Gas Company has its well sunk to a depth of about 900 ft., and expects oil in commercial quantities within the next 600 ft. This company is one of the best equipped on the ground. The Baker & Malheur Oil Company is drilling two wells, one of which is now 385 ft. deep and the other about 90 ft. The Oil and Gas Company has reached a depth of 1700 ft., but has not yet struck oil. The Columbia Oil and Gas Company's well is down 830 ft. The Eastern Oregon Oil Company has contracted to sink 3000 ft., or until oil is struck in paying quantities. Its equipment is on the ground.

Large bodies of oil sands and shales are exposed in this district, and some of the wells have brought up water carrying bubbles of gas and globules of a dark-colored oil. The oilfields are 300 miles from tidewater, and an easy grade is offered for a pipe line. As compared to other oilfields in this country, the problem of delivery to a port of export will be a simple one.

Gold Mining Industry in the Dutch East Indies

Poor Management and Many Wild-Cats Have Retarded Development. Radjang Lebong and Totok Chief Mines. Activity in Prospecting

BY E. A. WINTON

Few people outside of the Dutch East Indies are aware of the extent to which the mining industry has progressed in these islands. Probably 50 companies have been promoted and at present there are about 15 operating mines. Redjang Lebong, in Sumatra, is the largest producer and for a number of years has been a dividend payer. Shares in this company now stand at a premium of 900 per cent. The localities in which active mining operations are being carried on are the following: Redjang Lebong, Sumatra; Dutch Borneo and both coasts of North Celebes.

The story of the mining enterprises in these regions makes sorry reading for it presents a woeful picture of foolish speculation, misapplied energy and gross incapacity, all of which have naturally kept the industry back so that it is still in an undeveloped condition in spite of 20 years' work. The failure of a large percentage of the undertakings must not, however, be taken as proof that few or no workable mines exist. The circumstances hinted at above are enough to account for failures and moreover a big percentage of the enterprises were merely wildcats, anything being good enough to float when there was a boom on. Then too, in many cases shareholders and directors alike have been absolutely ignorant of all matters pertaining to the mining industry, the latter being for the most part commercial men, so that there has been a good deal of "the blind leading the blind." Unavoidable disadvantages, circumstances which nearly all the companies have been handicapped with, arise from the peculiar nature of the country, the difficulties of transport and from the nature of the deposits. However, the regions above mentioned do show promise and a few mines are at the present time successfully operating.

Redjang Lebong District, Sumatra

Redjang Lebong may fairly claim to rank among the notable mines of the world. Its monthly output averages about 400,000 fl. (£33,000). The mine is situated about 90 miles from the coast a little west of north from Benkoelen. Steam traction engines have lately been introduced to facilitate transport. The ore mined averages about 1 oz. gold per ton and carries from 7 to 8 times as much silver as gold by weight. The ore is reduced by stamps and tube mills, and practically the whole extraction made at the cyanide plant.

The Lebong Siman and Lebong Soelip companies operate in the same region and may be regarded as offshoots from Redjang Lebong. Both appear to have excellent prospects; the former has just reached the crushing stage, while the latter has been producing for over a year and in May, 1909, returned 114,000 fl. (£9500).

Operations in Dutch Borneo

The gold region of Dutch Borneo is indicated on the map accompanying this article. Mining operations have not advanced beyond the prospecting stage and appear highly speculative. Work is being carried on at Empalai, Behe, Landak Tajang and Sintoeroe, and a new Amsterdam syndicate is just starting up in this region. Diamonds are found in this district and are worked for by the Chinese.

The North Celebes Region

After many vicissitudes the Totok, which has been paying its way for quite a while, now appears to be entering upon a prosperous career, the grade of ore having lately improved. The average output for 1908 was 45,000 fl. (£3750) per month. The average value of the ore crushed has for a long time been just over 4 dwt. per ton varying between 2 dwt. and 1 oz.; the average value has lately risen to over 5 dwt. The ore is free-milling and contains some magnetite and traces of chalcopyrite. The best grade ore is at present being obtained from a quartz orebody in contact with limestone and calcite, the country rock being impregnated to a considerable extent. The ore is mined in open cuts, in part with the assistance of monitors; little tunneling is carried on. The mine is situated about 5 miles from the coast, transport being by bullock cart.

The mill equipment at the Totok comprises 40 stamps in two mills of 20 heads each, 2 Huntingtons and a puddler plant for washing clay from such rock as requires this treatment. Cyaniding was formerly tried but the peculiar adaptability of this ore to amalgamation makes this treatment unnecessary. Mercury is fed into the mortars and each stamp is operated at a duty of 4½ tons per 24 hours, crushing through a 30-mesh screen. The amalgam, after squeezing, contains from 39 to as high as 53 per cent. gold. The bullion, too, varies, and runs high in silver, the average content being about gold 697 fine and silver 280.

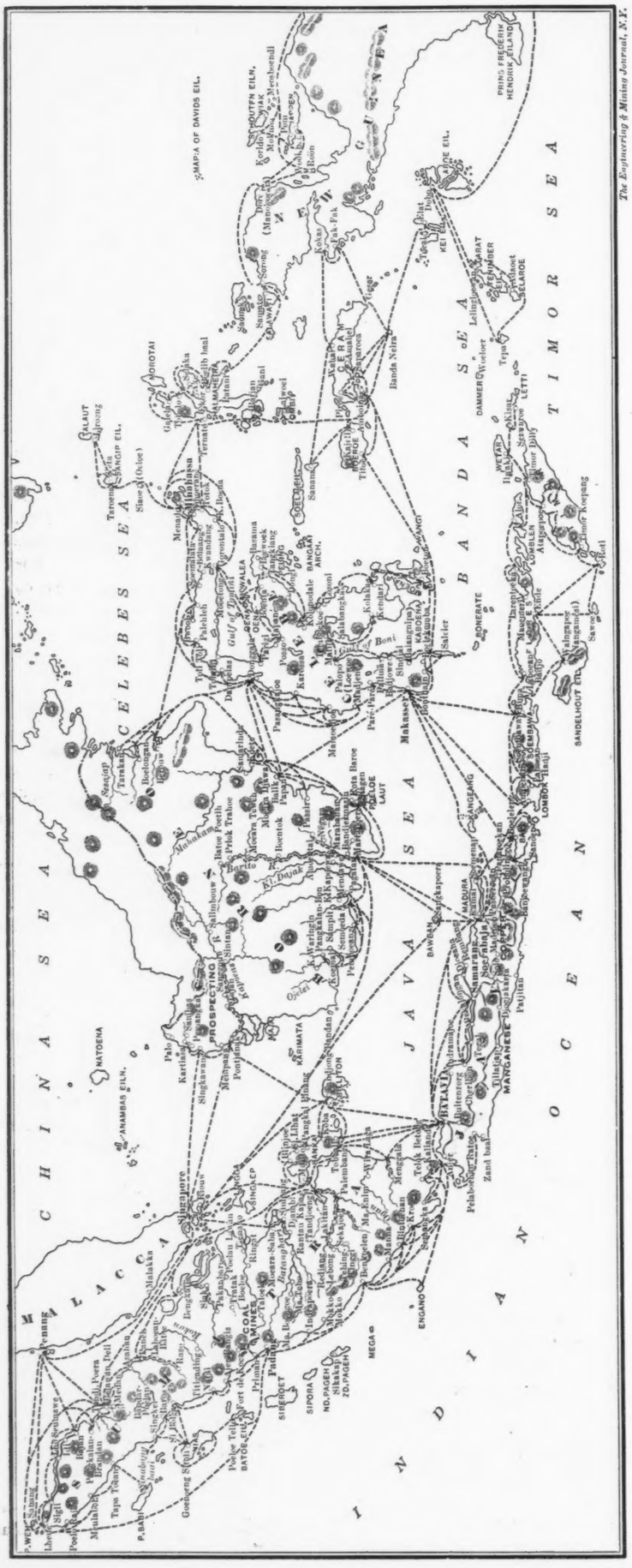
The workings are situated at the summit of a limestone mountain having an elevation of 1600 ft. The deposits are in the nature of stockwerks in crystalline limestone. There are intrusions of much decomposed andesite and basalt in close proximity to the orebody. The limestone dips about 30 degrees.

Waterpower generated by Pelton wheels is used to run nearly all of the machinery at both mills and at the mine. The water is conveyed to the mine through difficult country by a very fine piece of ditching. The total length of the ditch is over 25 kilometers and inverted siphons are used at four places in the line. The ditch was constructed very cheaply by native labor and is now maintained with little trouble or expense by the same labor under the charge of native foremen. At present four streams are diverted into the ditch and the system is shortly to be still further extended.

At Totok native workings were very extensive and an early inspector reported that they extended for many hundred feet down the mountainside and at one point a long irregular cavern, 80 meters long by about 10 meters high, in places having many branches, had been excavated. The method employed, as in British India, was to crack the rock by fire and water and then bar it down. The quartz was ground by hand between basalt stones and the sand panned. There is an outcrop of stibnite running over 60 per cent. antimony on this property but the company has never considered it worth developing. Some ore has been taken out and stacked.

The Palehleh mine is another one which has had a very hard existence. The money wasted there at the outset was enormous and quantities of expensive machinery which will never be used is still lying on an island in the harbor, and some at the bottom of the sea. It is problematical whether this mine will ever be able to pay dividends during the present decade whatever developments are made. The production, however, has been steadily, though slowly, improving, the figures for 1904, 1905 and 1906 respectively being, 273,707 fl., 324,545 fl. and 360,707 fl. Last May the production amounted to 40,000 fl. By all accounts steady and judicious development work is now in progress.

The workings are situated on a hill immediately above the sea. A large quantity of concentrates are produced and



MAP OF THE DUTCH EAST INDIES SHOWING MINING LOCALITIES

these were formerly smelted by the Soemalata company, but since that company suspended operations these are now being collected and will presumably be treated on the spot in the future. The Soemalata, which recently closed down, is situated not far from the Pelehleh property. The ore is exceedingly refractory, smelting being the only possible treatment and this apparently was not very successful, and the mine is very wet. Copper mining was started at Bwool but soon discontinued, and I am unable to find out anything regarding the particulars of this operation.

Other Localities

Extensive prospecting has been carried on along the coast southward of Totok. A mine was opened at Kotagoena, 8 miles from Totok in the low country, but has been abandoned. The ore at this mine, unlike that at Totok, is highly charged with pyrites and open cut work is not possible. Near here the natives are at present engaged in breaking rock which they treat by hand grinding and panning. I have assayed samples of this ore obtained from the natives which showed about 18 dwt. to the ton and did not carry much pyrites. The gold as at Totok is only about 700 fine. Two Dutch mining men have just commenced prospecting at a spot about 18 miles further to the south.

At Pagnat on the Gulf of Tomini considerable work, both mining and dredging, has been carried on, but abandoned in spite of the fact that both Europeans and natives who have worked there declare the place to be very rich. There are also persistent rumors that there is gold in south and middle Celebes and in Dutch New Guinea, but the Dutch have only a very limited hold on these areas and will not allow them to be opened to the public. I have a very rich specimen of rather impure gold, apparently roughly melted dust, brought from middle and south Celebes. As far as I am aware the only other important mining operations being carried on in the Dutch East Indies are, tin mining on the islands of Banka and Billiton (the Banka enterprise is a government undertaking and both are very successful), coal mining in the Ombilien coalfields on the west coast of Sumatra (principally by convict labor), copper mining in the Madjoen residency, Java, and manganese mining at Tjilatjap, Java.

General Conditions

The government is adverse to granting concessions to foreigners, and every syndicate must have a certain number of Dutch members. It appears that the government is desirous of developing the mining industry and all mining machinery is allowed in free of duty. There is a government royalty of 10 per cent.

on the gross output of gold and a tax on land of about 5 d. per yuow (4046 square meters). There is a Government Mines Department but it appears to concern itself only with mines worked by the government.

The climate in the Dutch East Indies is remarkably healthy as soon as one leaves sea level. Rainfall is of course very heavy. Skilled and unskilled labor is cheap but not as cheap as in British India and the Straits, living costs being higher. The supply, too, is not very abundant, because the country is fertile and the native is hardly under the necessity of working more than he pleases and as a consequence is rather independent. There is a good deal of sickness among the natives due to fever and epidemics of berri-berri and smallpox.

The islands being for the most part hilly and the rainfall heavy, water power will generally be available at least to some extent for mining ventures. Wood for fuel is generally plentiful but coal and coke are dear, coke costing as much as £7 per ton. Cardiff coal costs about 30s. per ton. Charcoal made on the spot is cheap. Timber for rough work is plentiful, but it is liable to rapid rot and good timber for special requirements is not plentiful. The islands are not thickly populated and government roads are scarce. Most companies have to go to the expense of making and maintaining their own roads, but the coasts are very well served by a large fleet controlled by the Packet company. The difficulties of transportation, as mentioned before, are the worst hardships encountered by mining companies operating in these islands.

Profits of the Rand Mines in 1908

At the annual meeting of the Transvaal Chamber of Mines, Feb. 25, 1909, the chairman, Lionel Phillips, made the following remarks:

I now propose to refer especially to the Witwatersrand, where, on account of the regularity of the yield comparisons are of greater value than they would be if they included the mines of the outside districts, although the latter, on account of their small relative production, would not make a great difference in the general result. On the Witwatersrand then, the profits earned were as follows: The Bonanza company distributed a final liquidation dividend, which I am not including. Forty-seven producing companies contributed £8,536,771. The market value of the shares of these companies on Dec. 31, 1908, was £83,352,448. Besides these, 22 more companies, with a market value at the same date of £13,663,416, were in the producing stage, but did not contribute to the dividends. It is interesting to note that adding together the amounts at which the market valued these dividend and non-dividend paying companies, the amount distributed is equal to 8.79 per cent. upon the whole of them.

Turning to the subject of yield and cost some instructive points arise. I am not in a position to give absolutely accurate figures per ton, because certain small items are not included in the ordinary results, but I may say that the profit per ton milled in 1908 exceeded that of 1907 by about 2d., this result having been achieved notwithstanding the value of the rock milled was less about 2s. 7d., owing to our having adopted the deliberate policy, for reasons which I shall explain later, of milling larger quantities of low-grade rock which, in former years, would have been left untouched. This shows that the working costs fell by 2s. 9d. per ton. According to our working-cost figures the approximate cost in 1908 was 18s. per ton, as against an approximate cost of 20s. 10d. in 1907, a reduction of 2s. 10d. per ton. The figures do not tally exactly, but as the difference is only 1d. per ton, they may be taken as accurate to all intents and purposes.

These figures have a great bearing upon the life of the mines. The following calculation, which it was possible to make with a very close approach to accuracy, demonstrates the effect of reduced working costs upon the quantity of ore that can be profitably treated. The calculation applies to 67 of the principal producing mines, whose working costs in January, 1908, averaged 19s. 5d. per ton, and in December, 1908, 17s. 1d. per ton. These companies had 60,000,000 tons of payable and unpayable ore developed. Owing to the fall of 2s. 4d. per ton in working expenses they were able to include in their total reserves of payable ore an additional 5,400,000 tons, being an increase of 9 per cent. I am not able to say what increase of tonnage this fall of 2s. 4d. per ton in working costs represents if applied to the whole Witwatersrand, but I need only call attention to the hundreds of millions of tons *in situ* to convey its significance.

Vidler Tunnel, Colorado

Special Correspondence

Notices continue to appear in the local press to the effect that the Vidler tunnel will be "rapidly rushed to completion," in order that it may be used by the trains of the Argentine Central Railway for the transportation of the ores and other traffic of the silver-lead-zinc Montezuma mining district, Colorado. The facts are that the Vidler tunnel under Argentine pass, west of Georgetown and Silver Plume, was driven 3800 ft. on this side of the Continental divide, and 700 ft. on the other side, and together with the mill and other surface improvements connected with the alleged rich veins intersected, cost a Christian Science coterie in London somewhere in the neighborhood of $250,000.

The tunnel and works were closed down about a year and a half ago, and the property was subsequently acquired by certain London creditors for about the cost of the surface improvements. There is now, we are informed, a contract out for the sale of the Argentine Central Railway. The matter of completing the tunnel is simply under consideration by those interested in the promotion, though, of course, it would be the making of the Montezuma district if such a railway connection were made, and the camp would send out a large tonnage. Meanwhile the tunnel, being about 7x8 ft. in size, would have to be enlarged its entire length for railroad purposes; and there remains one-half mile to drive to make connection between the two portals, the total distance being 7500 feet.

Borax Mining in California

Special Correspondence

It is expected that some of the borax mines on Frazier mountain on the northern edge of Ventura county, near the Kern county boundary, will soon start up again after an idleness of about two years. Russell Brothers, who have a mine between the Sterling and Columbus mines, have set miners at work on their property. Formerly the Sterling mine shipped to Bakersfield and the Columbus mine to Lancaster. When the price of borax suddenly dropped about two years ago these mines, like others in California, with the exception of the Lila C. mine of the Pacific Coast Borax Company, closed down. With the exception of the new mine of Stauffer Brothers in Los Angeles county, all these mines have since remained closed. The Ventura county properties, with a long haul to the railroad to pay for, could not be operated at a profit with prevailing prices of borax.

The developments on the South Eureka mine at Sutter creek, Amador county, Cal., are such as to again attract attention to big mines on the Mother Lode. The crosscut on the 200 level opened a splendid body of high-grade ore which averages two or three times as much as the general run of ore in that locality. Though the Mother Lode properties are always considered as carrying large bodies of low-grade ore, yet in most of the mines they occasionally come across exceptionally rich bunches. Dozens of instances of this might be cited. The Gwin in Cavaleras county, the Rawhide in Tuolumne and the Kennedy in Amador have found such places on several occasions. The South Eureka now comes in its turn.

Electrical Wiring for Deep Mining Work

By Carl L. C. Fichtel*

The successful and economical operation of any electrical apparatus underground in deep mining work, and particularly in the Lake Superior copper mines, which are low-grade properties requiring the handling of large rock tonnage, depends primarily upon the wiring. In laying out an installation in this field, where the current has to be transmitted to great depths, the problem resolves itself into two factors, mechanical and electrical.

Mechanical Features of Design

The mechanical features consist of installing and protecting the wire from outside interference (such as falling rock, crushing of timbering, etc.), the anchorage of the wires and the designing and placing of anchor and junction boxes and connectors.

After the size of wire and the thickness of the dielectric has been determined to meet the electrical requirements, and carefully considered from a mechanical standpoint that it may withstand all possible strains and the necessary hard usage in installing, ample allowance should be made in selecting the size of pipe or conduits (this being the only feasible method of construction) so that the wires can be easily drawn through without injury to the insulation, and also to afford ample ventilating space.

All pipe work must be done in such a manner that it is accessible at all points, out of the way of the skip road, and so placed and held that it will not interfere with, or be affected by the replacing or removing of timbers. The pipe line must be provided with drains so that there can be no accumulation of water at any point and a free circulation of air maintained throughout. This is done to eliminate the fungus growth that would take place if the line were practically air or water tight.

At points to be determined by the specific conditions, anchor or junction boxes are placed. These boxes are constructed so they can be readily opened, and of such size and shape as to take care of the anchor block or connectors and any excess wire that may come in through creeping.

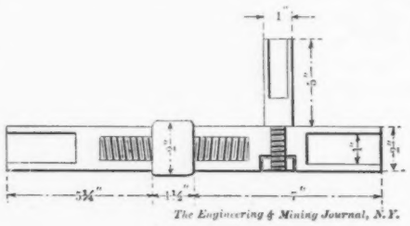
All connectors should be designed so they can be taken apart without disturbing the electrical connection with the wire on either end. Designing connectors for underground work is done from a mechanical standpoint; making them large enough to be easily handled where installed affords ample material for all electrical requirements.

*Electrical department, Calumet & Hecla Mining Company, Calumet, Mich.

The anchorage, or holding of the wires in the pipe, is of prime importance and great care must be exercised in the selection of the method to be employed, as there are several points that must be taken into consideration, viz.: weight of wire, angle or pitch of shaft, kind of pipe, nature and thickness of the insulation, temperature of the shaft and material and design of the holding device. The anchors should securely hold the wires without excessive pressure on the dielectric, which would cause a weakness of its insulating qualities at these points, and be so constructed as not to cause any short bends in the wire. As these points of anchorage are a possible menace to the reliability of any system, the least possible number consistent with a good margin of safety should be used.

Electrical Considerations

Electrically the wire must have carrying capacity to meet all the requirements for which it was intended without any heating or deterioration, and its dielectric must be of such character as to withstand changing temperature (ranging from 20 deg. below zero to 100 deg. F.), continuous moisture



CONNECTOR

and the action of mine water. The insulation of joints and connections must be done in such a manner that its insulating qualities will be equal to that of the wire in every respect.

No specific rules can be given for laying out this branch of electrical work as each property, or, in fact, each shaft has its own peculiar conditions and must be studied accordingly.

The Calumet & Hecla Mining Company was the pioneer of the Superior district in using electric power for underground work, starting in 1890 with a series of mine pumps geared to direct-current motors which operated at 1000 volts. These pumps were placed at intervals of 1200 ft. down the shaft to a depth of 4800 ft. This work has been under the supervision of F. N. Bosson, the company's electrical engineer, who has made a specialty of this branch of the profession and through whose efforts the company has a method of underground construction that is entirely successful.

A description of one of its recent installations is given herewith to show how conditions were met. The wiring carries current (3 phase, 25 cycle at 2300 volts) to a series of motors operating pumps, placed about 1200 ft. apart along the pitch of the shaft, which is about 52 deg. from the horizontal, to a depth of 4900 feet.

Specifications for Wire

The wire used is 500-000 cm. made by the Okonite Company, of New York, to meet the following specifications:

"All wires to be furnished to exact measurements; all wires to be tinned separately; all wires to have three braids, one regular and two outside of heavy jute; all wires to have not less than 7/32-in. wall; all wires to have three layers of insulation, joints broken 120 deg. apart; all wires to be stranded; all wires to stand an insulation test of 2000 meg-ohms after three days soak, then a 6600-volt disruptive discharge after a further soak of three days, and to show no weakness or deterioration between the first and last test." The wire furnished has an outside diameter of 1½ in. and weighs nearly 2.5 lb. per foot.

Pipe Work

Plain wrought-iron pipe is used throughout to contain the wires, as it has been found the most economical under the conditions. Each length of pipe was carefully gone over and a large chain drawn through it so as to rid it of all possible burs or projecting edges that would be injurious to the insulation. The pipe is 5 in. in diameter, which allows an easy passage of the wires through it and affords ample ventilating space around the wires. The pipes are laid in the ladderway, upon the base timber and the dividing piece upon which the ladders rest. They are held from slipping by means of yokes that are securely clamped around the pipe and have their ends resting against an iron plate fastened to these timbers. As these yokes are not fastened to the timbering, they allow of considerable settling or shifting without affecting the line. These yokes are placed 100 ft. apart. At intervals of 300 ft. anchor boxes are placed and at the stations junction boxes.

Anchor and Junction Boxes

The junction box used in this installation is shown on an accompanying sketch, the anchor boxes being the same with the exception of not having the side flange for the take-off pipe. They are made of cast iron and left in the rough, the cover being bolted on without gaskets to allow the circulation of air through it. In each corner of the box is a ¾-in. cored hole to allow any water to drain out, each box taking care of the pipe above it. Thus the line acts as a ventilating duct, a free circulation of air being maintained throughout.

Installing the Wires

To expedite the handling and installation, the wires were made in lengths equal to the distance between stations, with an additional 20 ft. for reserve purposes. This made each run equivalent to about

3700 ft. of wire and weighing nearly 4½ tons. The reels holding the wire were set up underground at the top of each run (starting with the lowest), the ends of the wire were fastened to the bottom of a timber car, which was attached to the hoisting rope, and in this manner the wire was slowly unwound from the reels into the shaft and held suspended there while the bottom ends were placed in a long cone-shape sleeve which prevents the ends from fraying and eliminates the possibility of any of the wires in the strand catching. These ends were then attached to a 1¼-in. hemp rope that had been previously drawn through the pipe.

The wires were started down the ladderway at a point about 75 ft. above the junction box at the top of the run, thus eliminating any short turns and giving the wire a smooth run for this distance. The ladderway was covered with plank and a piece of round timber was set up in the shaft to deflect the wire from the shaft into the ladderway. After the wire was well entered in the pipe, very little pulling was necessary by the men at the lower end as its own weight and stiffness forced it through.

Men were stationed at each box to see that it did not catch at any of these points, causing temporary slacks that would give a jerking motion and subject the wire to unnecessary strains.

After the wire was thus installed it was securely clamped at the bottom anchor box, about 300 ft. from the end of the run, then slackened just a little and the remaining blocks fastened.

Another Way of Handling the Wire

This method of installing was used on the two bottom runs, but on the third (from the 12½ to the 25th level) the distance from the point where the wires entered the ladderway to surface was less by about 100 ft. than the wire run, so it was necessary to loop the wire in the shaft. This was accomplished by the aid of a second timber car operating on the other side of the shaft, the shaft being a two-compartment one with the ladderway between the compartments.

The wire was unwound from the reels and held suspended in the shaft, a clamp was placed on it about 150 ft. from the end, and this was attached to the other car by means of a hemp rope which was run between the dividing timbers through single pulley blocks. This car hoisted the wire up the shaft a sufficient distance to allow it to enter the ladderway, taking a long turn in the form of an *S*. The car was then lowered until all the weight came on the first car, when the clamp was removed and the first car lowered it through the pipe.

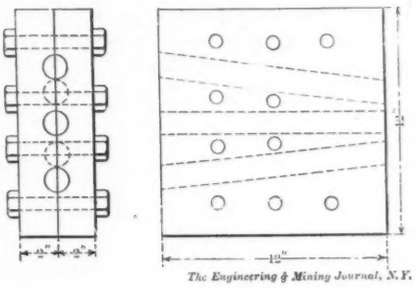
The top run, from surface to the 12½ level, was handled by a 50-ton locomotive. The wire was laid on the surface beside the railroad track which makes a right angle with the mouth of the shaft. A framework of timber was set up to form a turn sheave for the wire.

Men carried the wire, a few feet at a time, until enough was entered in the pipe to carry the weight of the portion remaining on surface, the pull then coming on the locomotive which backed slowly, allowing the wire to slide through the pipe.

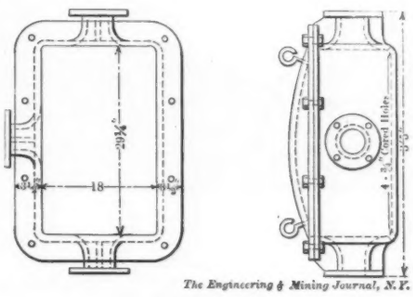
In lowering the wire into pipe in this manner it assumes a long, easy twist, causing the transposition of the phases in such a manner that it practically eliminates all inductive effects.

Anchoring

The anchor blocks are made of well-seasoned oak, and are boiled in a mixture of paraffin and beeswax for 36 hours, thus making them as nearly waterproof as is possible, and thereby avoiding practically all swelling or warping. The holes are bored ¼ in. smaller in diameter than the outside diameter of the wire and the two outside holes are made slanting so as to spread the wires and make room for the connectors. The two halves of the blocks are bolted together by ten ¾-in. bolts, and great care is used in putting them together so that they are absolutely tight, wood to wood at every point, to avoid the possibility of water accumulating between the halves.



ANCHOR BLOCK



JUNCTION BOX

These blocks are placed in the anchor boxes with the end of the block at which the wires are closer together resting against the bottom. The over-all distance between the two outside wires is then less than the inside diameter of the pipe, thus giving a straight run and avoiding any chance of squeezing the wire between the anchor block and the box.

Connectors

The connectors are made of cast copper and of such dimensions as to withstand the necessary mechanical strain that come upon them in making and breaking connections. An accompanying drawing shows the design of the connectors used. The two ends are soldered to the wire and held together by the right- and left-hand threaded connecting piece. One of these ends is made longer than the other to allow for the take-off connection. The take-off connector consists of a copper bar, drilled at one end to take the wire, and the other turned down and threaded for a regular nut, being fastened to the main connector as shown.

Great care is observed in taping the connections, several layers of rubber tape being used. The tape is softened by means of a blow torch as it is being applied and worked until it becomes a solid mass. This is done until a thickness a little larger than the insulation of the wire is reached, when it is thoroughly covered with friction tape. Each one of these connections required ten ½-lb. rolls of Okonite tape and two of Manson.

During the electrical reconstruction at the mine about six years ago, the wire that was put in to operate the first series of pumps was taken out of the shaft where it had been for nearly 13 years, and the installation was found to be in first-class condition. The wire, with the exception of the outer braiding, which had become fastened to the pipe through corrosion and was badly torn in pulling it out, was found to be in such good shape that it was used again in various other places. All joints and points of anchorage were practically the same, thus showing that this method of installation meets the local conditions in the best possible manner.

Pig Iron from the Electric Furnace

Special Correspondence

The first pig iron made in the electric furnace, which has been put on the market commercially comes from the plant at Heroult, in Shasta county, California. This plant uses furnaces of the Heroult type, and electric power is furnished by the Pit river. The first regular shipment was 20 tons of pig iron delivered in Redding. The electric furnace in operation is turning out about 25 tons of iron daily and delivering it at a cost less than the price at tidewater in California. Some few changes have still to be made before the process will be considered completely successful.

Wages paid at the Hanyang Iron works in China are 10c. a day for ordinary labor; 24 to 30c. for mechanics and furnace men of ordinary grade, and from $1 to $1.20 per day for boss furnace men and rolling-mill men.

Notes on Some Ore Deposits of Porto Rico

By S. Harbert Hamilton*

Having spent a few months in making an economic geologic survey along a proposed railroad line in Porto Rico, I offer the following notes, not as a complete report, but only as a small contribution to the economic geology of the Island.

Topography and Geology

The topographic development of Porto Rico consists of a main mountain mass known as the Luquillo range, mostly composed of syenitic rocks. This is flanked by hills of porphyry which, in turn, pass into a dissected peneplain of limestone and sedimentary rocks going to local base level and often ending in alluvial flood plains and littoral swamps.

All the mineral deposits seen by me were in the flanking hills, or "chuchittas," which are composed of a basic diorite-porphyry. Where any pseudo-stratification has taken place, the strike appears northwest and southeast with a steep dip. Very little local folding was observed. The most notable structural feature is crushed or brecciated zones which have been ascribed to earthquake cracks.

The exceedingly mountainous character of Porto Rico and its many deeply cut river gorges not only make railroad building difficult and expensive, but also tend to prevent profitable operation, owing to the comparatively small valleys to be served and the relative shortness of the haul. Porto Rico is a small island, and with its diversified surface is destined always to be "the land of the bull cart."

Iron Ores in the Vicinity of Juncos

The occurrence of iron ores in the West Indies has long been known. Those on the south coast of Cuba are the best developed. At a number of places in Porto Rico, outcrops and talus apparently similar to the Cuban "south coast" ores occur. The deposits most thoroughly studied by me are the claims in the vicinity of Juncos, of which the following notes were written:

The chief mountains of Porto Rico are composed of syenite. They trend north of west and rise to hights of almost 4000 ft. in the Luquillo mountains, in which is El Yunque the dominant but not the highest peak. Paralleling them are the chuchittas, or hills of less than 1000 ft., in which the orebodies are situated. At the foot of the chuchittas is an old dissected peneplain through which a changing river system is cutting its way. Road and railroad construction through this sort of country is exceedingly difficult, as the ridges are a series of knife edges and hog backs, and the valleys are steep and narrow. The streams have started meanderings over the old peneplain and these irregular lines of drainage have been maintained.

The surface is practically all under cultivation and there is no timber of any account to be found near at hand for mine purposes. The rainfall appears to be heavy and the country is well watered with small streams, although it may be necessary to store some water for large power plants. The country side is all well settled, and probably mining camps can be easily be supplied with food from the neighborhood. There is nothing especially unhealthy in the climate.

Geological Features of Iron Deposits

The country rock is of igneous origin. Tomlinson, having made a petrological analysis of samples sent by us, calls it "diorite-porphyrite." It consists of phenocrysts of pyroxene and feldspar in a base of feldspar and chlorite. Magnetite occurs in the base in small, but frequent grains. He says, "I would suggest that these grains were probably formed during the alteration of the rock. They do not look like original constituents." In this rock occur the orebodies in association with the vesuvianite. There are no garnets, micas, hornblende, nor any of the platy minerals that are often associated with magnetite orebodies. The vesuvianite and quartz, with which the ore is sometimes associated, separate easily from it in crushing. The decomposition of this rock produces a very sticky, fat clay which resists erosion remarkably well. The magnetite remains in large irregular talus blocks.

Since their formation, these blocks have been subjected to mountain-making forces, which have changed them in some rare instances into a slate. They then have a trend northwest and a nearly perpendicular dip. In their most frequent phase, however, they occur in irregular rhomboids, parallelopipoids and similar forms, which, owing to their small size and chloritized condition, will make a very bad hanging- and footwall. The same seismic disturbances that fractured the wall rock also divided the ore so that diamond drilling is found to be difficult, and churn drills are better suited to prospecting in areas where earthquakes have disturbed the rocks.

Iron Ore an Igneous Segregation

In origin, I consider the ore to be an igneous segregation from a ferric-dioritic magma which has come in contact with limestone. Traces of such limestone are to be seen. It may be assumed that these intrusions had a genesis in what has been called "magmatic stoping;" i.e., the original magma ate its way by assimilating the limestone and freeing the iron. The magma would then separate by gravitative adjustment, with the lighter vesuvianite material on top. Thus the eutectic balance would be disturbed and fractional crystallization be set up, each crystal, especially the magnetite, tending to segregate about previously formed ones.

This hypothesis accounts for all the phenomena observed, and in all probability no movement of magnitude has taken place since these deposits were formed. The fact that where extensive erosion has taken place there is no vesuvianite present would indicate only that the ore would become better with depth in places where it is now mixed with silicate at the surface of the outcrops.

OUTCROP OF IRON ORE EAST OF JUNUS

Minor faults have unquestionably occurred and slicken-sided surfaces are frequently seen. There do not seem to be any faults of the "offset" type so frequent in iron orebodies. Dikes of granite occur, but none were observed in or near the orebodies.

Copper Ores

The West Indies have long been known to have deposits of copper, the mines at El Cobre, in Cuba, being the oldest and best known. In Porto Rico, traces of copper minerals are found at widely separated localities. The following notes were made after a brief visit to a prospect near Mororis:

The deposit apparently consists of an impregnated breccia forming a sort of

*Mining geologist with Hamilton & Hansell, mining engineers, 29 Broadway, New York.

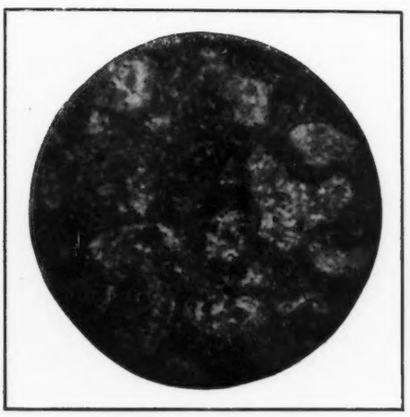
stockwork. The extent of this breccia is unknown, as all workings are very shallow, and its origin is obscure so that it is impossible to say whether it is the result of a giant tort, as certain features of the topography indicate, or only a small earthquake crack that has offered easy means of impregnation.

The minerals are of the usual gossan type; chalcocite, chryscolla, malachite, limonite, quartz, kaolinized feldspars and chloritized ferro-magnesian silicates passing into sticky (tosca) clay. Sampling over a considerable area showed the whole mass to average about 4 per cent. copper.

Other Minerals

Gold—Placer gold has been found in many places in Porto Rico, and a small amount of washings is sent into San Juan in trade. Some attempts have been made at serious mining near Corazal, but the equipment seems to have been ill advised.

Lignite—A matter of considerable importance to Porto Rico is the fuel supply. Wood and charcoal, with bagasse, have been the only local fuels. The supply of wood and charcoal is rapidly becoming exhausted, and the sugar centrals do not produce sufficient bagasse to fully supply their own wants. The lignite, of which I have seen only samples, is too heavily charged with pyrite to yield an available fuel, but if the deposit, on exploration, proved of any considerable size, it might pay to refine and briquet the material.



MICRO-SECTION OF DIORITE-PORPHYRITE

Pyrite and Phosphate—Both these minerals, so important to an agricultural community, exist in Porto Rico, but efforts to determine their quality and quantity have not been made.

An important gold discovery is reported (*So. Afr. Min. Journ.*, July 31, 1909) on the Grootrivier No. 2321 farm to the southwest of and adjoining Solomon's Temple, in the Waterberg district of the Transvaal. The gold occurs in a contact zone between conglomerates and felsites.

Compensation to Workmen for Accidental Injuries

By M. M. Duncan*

I desire this evening to call your attention briefly to the urgent necessity for a change in the laws governing personal injuries. At present, workmen have no protection or remedy for accidental injuries. Employers are only liable for negligent injuries, that is, such as from the neglect on the part of the employer of some duty the law imposes upon him. This leaves out of consideration, all injuries growing out of the momentary thoughtlessness or carelessness of the employee or of his fellow workmen. A large proportion, estimated as high as 75 per cent., of all the injuries received by workmen in this State are due to causes for which the employer is not legally liable. The entire burden growing out of such accidents is thus placed upon the injured family, except as relieved by charitable of philanthropic contributions on the part of the employer.

Necessity of Compensation Laws

As civilization advances and human needs increase, we find that the hazards incurred by the workman become greater. This is noticeable in every industry. The construction of skyscrapers in the cities, of great bridges and tunnels, the operation of enormous furnaces and steel plants, of deeper mines, the application of electricity and the ever increasing volume of traffic on our railroads, present more numerous and greater hazards than were known to the workman of 25 years ago. The effect of this is shown in the great number of accidental deaths and injuries constantly occurring.

Public sentiment demands and public policy requires the adoption of laws which will give employees adequate compensation in case of accidental injuries, as well as for those which I have called negligent injuries. Our present system is unjust from an economic standpoint and has been discarded in every industrial country in the world except our own and Canada. Under our form of Government, Federal laws governing this question, except possibly as applied to interstate commerce, are not constitutional and therefore each state must act independently. Up to this time nothing has been done, except that some states have enacted laws removing or modifying certain legal defenses which were heretofore available against employees in personal-injury suits.

This has not proved to be a satisfactory way of helping injured workmen or their families. On the contrary it seems rather to be a system devised to help energetic and unscrupulous lawyers. In such states a class of practitioners has grown up to prey upon both the injured employee and the employer. They demand from the injured workman or his family a large compensation, usually one-half, of all that is recovered, for their alleged legal services and on the other hand they seek by every means, often not hesitating at fraud or perjury, to secure large verdicts against the employer regardless of the merits of the case. Such a system is thoroughly bad, legally and morally. It creates distrust of the courts and constant irritation between employer and employee.

Employers of labor are beginning to understand the economic value of human life, and the importance from a business standpoint of protecting and caring for their employees. This is shown by the adoption of new appliances and safeguards to prevent injuries. It is shown in the erection of club rooms, libraries, and in the maintenance of hospitals and the employment of nurses and physicians. But it is time to go a step farther and make each industry provide suitable compensation to the injured workman, and in case of death to his family, and to do this in a way which will insure their getting it, also promoting better relations between the workman and his employer.

This question is a public one, whether we would have it so or not. The care of orphan children and indigent relatives is an expense borne by the State. The maintenance of courts, the payment of judges, jurors, and court officials engaged in the trial of these cases is not by general taxation. And finally, the general welfare of the laboring class is intimately related to the best interests of the State.

I will not attempt to do more than to suggest a remedy. I think that in order to enact laws which will be just to both employer and employee, a careful investigation should be made of the systems adopted in other great industrial countries, and the results obtained therefrom, as well as the collection of data in respect to accidents, and the various methods of dealing with them in this country.

At the last session of the Minnesota legislature, a commission was created to make such an investigation, and submit a written report with its recommendations to the legislature of 1911. Its members serve without pay but an appropriation of $5000 was made to cover their expenses. It is interesting to note that this commission was created at the request of representatives of both employers and employees. This is unquestionably a step in the right direction, and our own State of Michigan might well follow its example.

English Employers' Liability and Compensation Laws

In our states, liability for personal injuries rests upon the principles of the common law of England, supplemented

Note—An address delivered to the Lake Superior Mining Institute, Aug. 25, 1909.

*General manager, Cleveland-Cliffs Iron Company, Ishpeming, Mich.

somewhat by statutes and court decisions, yet as long ago as 1880, England concluded that this system was insufficient and adopted a stringent Employers' Liability Act. Even this proved unsatisfactory and in 1897 Parliment adopted the Compensation Law based on the entirely new principle that every business must make measured compensation to workmen injured in any way in the ordinary course of employment, unless there was gross fault on the part of the employee. The workman is not required to prove negligence in the employer, in order to secure indemnity, but only the fact that he was injured in the course of employment. The amount of indemnity paid in case of injury or death is based upon the wages earned, and ranges from $750 to $1500 in case of death, with lesser amount for injuries. I mention these rates only by way of illustration. The proper rates to be adopted here must obviously be a matter for careful investigation. Under the English system, the injured workmen may choose whether to bring a suit for damages under the common law and employers' liability act, or to take the indemnity given under the compensation act. He cannot collect under both acts, but if he brings a suit for damages and fails, he may still proceed under the compensation act, although the employer may offset the costs incurred in the first suit.

Experience has shown that injured workmen much prefer the compensation law. The obtain their indemnity without the delay and expense incident to litigation and without any controversy with their employers.

Whether it is desirable for us to adopt the English system, or some modification of that and the German system, I will not here stop to discuss, but I wish to emphasize the point that compensation to the employee, rather than punishment of the employer, is the correct basis for whatever system is adopted. I know that the large employers of labor are earnestly striving to protect and safeguard their employees from injuries. The theory of negligence upon which verdicts are rendered, is in most cases a mere legal fiction. Juries act upon sympathetic motives rather than because of any conviction that the employer has been really negligent. In fact, I think that the average juror takes this method of showing his disapproval of our entire system, through which only a small proportion of injured men get any redress whatever. But in spite of all precautions, accidents and even deaths are unavoidable in every industry. The principle of compensation is that each industry shall pay in such cases some just and adequate amount, not as damages collected from some alleged negligent employer, but as a method of fairly distributing the extraordinary risks of civilization. Such payments become a part of the cost of production, like expenditures for broken-down or worn-out machinery, and if required by law, so as to place all producers on the same basis, would not be detrimental to the employer.

The German Benefits Scheme

In Germany, this result is accomplished by a system of industrial insurance. This system has been so developed as to include not only accidents, but sickness and old-age pensions. Accident insurance is compulsory for all workmen and foremen earning less than $720 per year. The premiums are paid entirely by the employer, and are collected in assessments based upon the wages paid, and the scale of risk in the business. Insurance is carried in associations of employers, regulated by the government, and these associations insure those in the same or similar trades, thus practically placing each industry by itself. The benefits paid during disability, or after death to dependent relatives, are based upon the scale of wages. The death benefit is an amount 20 times the daily wages, and a pension to dependent relatives up to 60 per cent. of the daily wages. The benefits during disability range up to two-thirds of the annual earnings, or free hospital treatment with a pension to dependent relatives up to 60 per cent. of earnings.

These benefits, though small, are paid without any litigation over questions of negligence, and in case of controversey the dispute is settled without expense to the parties by an arbitration court.

Under this system, there was paid in 1906 the sum of $34,368,000 to 354,680 injured and to 73,999 widows, 103,564 children, and 3882 parents of those killed. Yet this result was accomplished at an average cost of only $2.18 per insured. These associations covered 19,200,000 workmen, and the premiums collected amounted to $40,080,000.

If we compare the German system with our own method of casualty insurance, the contrast is startling. It was recently estimated by a careful and painstaking writer that not over 35c. of each dollar paid as premiums to casualty companies ever reaches the injured employee or his family. The balance is absorbed in fixed charges, operating expenses, attorney fees and the payment of dividends to stockholders in the casualty company. In Germany, almost the entire amount of premiums paid goes to the proper beneficiaries.

I will not follow in detail the various features of the German system, but after a trial of more than 25 years, all parties are agreed as to its advantages. And during this same period Germany has advanced to a high position in manufacture and commerce and the condition of its workingmen has so improved that emigration has materially decreased.

The German industrial insurance is undoubtedly more effective than the English compensation act, but both systems are worthy of the most careful consideration and should enable us to prepare suitable laws for our own State.

While I have referred to these two systems at length as affording the most conspicuous examples of desirable legislation, it is also worthy of notice that France, Austria, and Sweden, and practically all the industrial countries in Europe have adopted some system for the protection of their workmen. The British colonies with the exception of Canada have followed the example set by England. Our own country, so progressive in other respects, is a laggard in legislation of this character.

An Economic Question

I regard this as an economic question, and I am expressing these views from that standpoint. The payment of such indemnities or insurance to injured men or their families is a matter of common justice, and our laws ought to be changed so as to require it. Such a system would be infinitely better for both employer and employee than to have the same amount distributed from charitable or philanthropic motives. I firmly believe that the representatives of employers and employees should unite in asking the next legislature of Michigan to create a commission, following the example of Minnesota, to give this subject careful consideration and draft a suitable law. I feel sure that the adoption of some such system as I have discussed will be of the greatest benefit to both employer and employee as well as being for the best interests of the State.

The government has just issued the half yearly figures of production of diamonds in the Transvaal. The output for the half year was valued at £580,807, as against £714,409 in the previous half-year, a decrease of £133,682. The number of loads washed fell from 3,858,186 to 3,689,469 and the number of carats from 1,002,754 to 926,738. The value per carat during the past six months was just below 12s.6d. ($3.04). Five companies and 18 individual diggers contributed to the output.

A. M. Bilsky, of Cobalt, and J. A. Jacobs, of Montreal, are to construct the first concrete building to be seen in Cobalt. It will be erected on the site formerly owned by the Royal bank, and is to be an office building six stories in hight. It will be fireproof, being constructed of reinforced concrete throughout. It is understood that four floors have already been engaged. Work has been started tearing down the old buildings to make ready for construction.

Three oil wells have been opened on the island of Trinidad, in the West Indies. The wells are near the coast and not far from the famous Asphalt lake. They are owned by the New Trinidad Asphalt Lake Company.

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Contents

PAGE

Editorials:
Protection of Mine Investors..... 521
New Explorations in the Lake Superior Region..... 522
Estimating Grade of Ore..... 522
*Brief Notes on European Coal Mines. *Floyd W. Parsons* 497
Shooting Off the Solid..... 499
The Phenomena Preceding Gas Explosions.....*Francis Laur* 500
Colliery Notes..... 502
*Free and Hindered Settling of Mineral Grains.....*Arthur O. Christensen* 503
*An Urgent Pumping Problem and How It Was Solved.....*James A. Seager* 509
*Novel Spoil Transporter for Stripping Operations.....*Fred A. Talbot* 510
Condensation in Steam Pipes..... 512
The Malheur Oilfields of Oregon. *Special Correspondence* 512
Gold Mining Industry in the Dutch East Indies.....*A. Winton* 513
Profits of the Rand Mines in 1908..... 515
Vidler Tunnel, Colorado. *Special Correspondence* 515
Borax Mining in California. *Special Correspondence* 515
*Electrical Wiring for Deep Mining Work.....*Carl L. C. Fichtel* 516
Pig Iron from the Electric Furnace. *Special Correspondence* 517
*Notes on Some Ore Deposits of Porto Rico.....*S. H. Hamilton* 518
Compensation to Workmen for Accidental Injuries.....*M. M. Duncan* 519
Developments at the Dolcoath Mine. *Special Correspondence* 523
Correspondence and Discussion:
The Vermont Copper Company. *John N. Judson* 524
Regulation of Gas in Mine Air Currents.....*M. I. Hachita* 525
Sulphide Corporation. *Minerals Separation, Ltd.* 525
The Assay of Cyanide Solutions for Gold Content.....*W. F. Boericke* 525
Details of Practical Mining:
*Toggle Joint Gate..... 526
*The Saddleback..... 526
*Automatic Safety Clutches..... 526
Surface Plants Over Mine Workings 527
Speed of Pelton Wheels..... 527
*Grading a Drive or Tunnel..... 527
*Labor Efficiency in Mining Operations. *Peter B. Scotland* 528
Personal, Obituary, Societies and Technical Schools..... 530
Special Correspondence..... 531
Mining News..... 534
Markets..... 539
*Illustrated.

Protection of Mine Investors

The Mining and Metallurgical Society of America, after a discussion of nearly a year, has adopted the following resolutions:

"Whereas, the over-valuation of mining properties by investors and the public, due to ignorance of mining conditions and a lack of appreciation of the real nature of the investment, tends to increase unduly the profits of mine promoters and speculators, and to increase unnecessarily the financial risks taken by mine investors, to the ultimate disadvantage of the mining industry,

"Resolved, that it is the opinion of the Mining and Metallurgical Society of America that, for the protection of shareholders and investors, every mining company should publish an annual report within 90 days of the close of its fiscal year, and such report should incorporate the following information:

"1. A brief review of the past history of the property, the work accomplished and the results obtained, with tabulated statement of expenditures and receipts from the beginning, marketable products made each year, and the sums received from the sale of same, the annual net earnings and the disposition made of such earnings.

"2. A similar review, but in more detail, of the work of the year, with statements of the assets and liabilities (these statements to show all details as to capitalization of the company; the number and classes of shares outstanding at date of the report; the respective rights of these shares; the number of shares remaining in the treasury; any options or contracts on such shares; any bonded indebtedness), receipts and disbursements, cost sheet and other information as to work accomplished and results obtained.

"3. A statement of ore reserves at the date of the report, compared with the reserves of the previous year, with an estimate, by competent authority, of the probable life of the mine."

The Mining and Metallurgical Society, although comparatively small in membership, is representative of the mining engineering profession, and its expression of views as to what the investors in the shares of mining companies ought to have should be of some weight as the consensus of excellent professional opinion respecting this matter.

Taking up the resolutions, article by article, we conceive that the purpose of the first article is to throw light upon the actual cost of production. It may be argued that data of the past are no criteria as to the prospects for the future. They afford, nevertheless, the best possible basis for making estimates as to the future, whch may be reduced or increased according as the latest knowledge as to the mine indicates ought to be done. On the other hand, it is well recognized that the report of a mining company for any single year is likely to be misleading—because maintenance and development expense may be temporarily neglected, etc.—while the average for a reasonable series of years will tell the story. This appears to be the principle of the first article, and as such we consider it to be wise.

The second article specifies simple data that every shareholder is certainly entitled to, and ought to have. Many mining companies—perhaps the majority—fail to communicate all of this information. If the purposes of the management of the companies are perfectly straightforward, there is no reason, however, why there should be concealment or reticence as to any of these particulars.

If every mining company should comply with the specifications of article 3, there would be fewer scandals and less deception of unwary investors in mining shares. In the discussion of these resolutions, this article excited more argument than either of the others. It was urged, among other things, that it is impossible, in the majority of mines, to estimate the probable life, and any engineer who attempted it would generally be playing into the hands of illegitimate finance. We think that the members of the society who voted for these resolutions by a large majority recognized fully the impossibility of forecasting absolutely the life of any but the exceptional mines and do not expect infallibility even from competent authorities; but they indicate that the stockholders of a mining company should have such a frank and honest statement of conditions and prospects as one partner in charge of the operation of a property would make to another who was absent. Certainly, the investing public has been benefited by such frank statements as to the probable life of the mines as have been made in the cases of the Calumet & Hecla and Broken Hill Proprietary.

The resolutions adopted by the Mining

and Metallurgical Society are certainly conservative inasmuch as they ask nothing more than is done already by a good many of the substantial and well managed mining companies. Inasmuch as so many of such companies can do these things, there does not appear to be any good reason why all companies should not. It is to be hoped that the public will learn to discriminate between those that comply with the standard that is now established by the Mining and Metallurgical Society and those that fail to do so.

New Explorations in the Lake Superior Region

Although iron mining has been carried on in the Lake Superior region for half a century, no limit seems to be yet set to its possibilities. The extension of the district beyond the "Old Ranges"—the Marquette, the Menominee and the Gogebic—by the opening of the Vermilion range in Minnesota, and later by that of the Mesabi range, turned exploration to the north and west and the older ranges for a time ceased to be the scene of much active prospecting work. The rapid extension of the Mesabi to the westward and northward for a time satisfied the demand for new sources of ore supply. The limits of that range have not been set, but most of its deposits of proved or probable value have been taken up, and are now being worked or explored by the owners.

A limit having been set in this direction, a new wave of exploration was started on the older ranges of Michigan and Wisconsin, which has resulted so far in the discovery of a number of orebodies formerly unknown, some of these constituting new mines while others promise valuable additions to the lives of older mines. The success so far met with on these ranges has stimulated exploration, which is just now especially active on the Menominee range, with very good prospects of success. This work is going on not only in the vicinity of some old mines, but also in several districts which had been supposed to be comparatively barren and unprofitable, and had been neglected.

The Vermilion range has been comparatively neglected of late, especially since the partial closing of the Chandler and the Soudan mines, once two of its largest producers. Now, however, it has again come forward, and has been accepted as a possible ground for new discoveries. Exploration on this range is slower and more expensive than on the Mesabi, where it has been possible to determine the position and approximate size of many of the orebodies by the diamond drill alone. On the Vermilion drilling has proved uncertain and sometimes untrustworthy and the slower process of sinking test shafts is required. Preliminary boring, however, has given such promising results that several of these shafts are to be sunk, work on some of them having already been begun. It is too soon to predict the results, but there is certainly promise enough to warrant the expenditure of the capital required.

The Lake district since its first discovery has shipped 430,000,000 tons of iron ore. Estimates of its probable reserves and future life have been various. It is evident in the light of recent discoveries that such estimates need to be radically revised, as compared with those of two or three years ago; and it looks as if such a revision would be required periodically for some time to come.

Estimating Grade of Ore

In sizing up a mine there are two factors that are apt to be misconceived, viz: the cost of mining and the grade of the ore. As to the latter it happens generally that in spite of all refinements in sampling, there is an over estimate. This is due to several reasons. The sampling of the pay streak may be correct, but the pay streak can seldom be extracted cleanly. Often it is necessary to take out more of the wall rock than was contemplated in order to get at the ore and it is impracticable to separate the lean or barren material. In the mining of great masses of ore, as in the porphyry copper mines, it may prove essential to take out lean portions in order to get at the better upon which the estimates were based. A block of moderate size showing good ore on four sides may prove to have a barren core.

Nature sometimes plays queer pranks and deception may arise from the very perversity of things. We recollect a case of an exploring drift on the strike of a lode which cut a streak of good ore for 100 ft. or so, ore showing in roof and floor all the way without a break. When the ore was stoped it was found to be an elongated body, lying horizontally, that in no place was more than 30 ft. high and for much of its length only 10 or 12 ft. The drift had happened to go through it like the lead through the wood of a pencil.

The conservative diagnostician is bound to regard every orebody with some spirit of pessimism. But, says the optimist, may not the converse sometimes happen? May we not in the extraction of a body of low-grade ore find unexpected pockets of rich ore within it when we take out the whole? Yes, this may happen. We have known such cases. But they are less common than the other experience. Pockets of good ore are apt to throw out stringers, leaders, or some sort of clue, which cause miners to follow them to their heart. On the other hand, no prospector follows a leader of lean ore.

After the sampling of a mine has been done with the utmost care; after it has been checked and rechecked; and after it is thought that the grade of the ore is really known, it is advisable to discount the belief by some moderate percentage to allow for such adverse contingencies as we have sketchily indicated. Perhaps this ought not to be necessary, but experience seems to manifest that it is.

The statement that the New River and Pocahontas coal operators are concerting measures to regulate shipments will be welcome news to the other districts which furnish bituminous coal to the seaboard. The unrestricted competition of West Virginia coal and its sale in Eastern territory, apparently without regard to price, has deprived the trade of all profit for many months past.

Without considering the Ballinger-Pinchot controversy and without deprecating the basic idea of conservation—grand in itself—what a relief it would be if the calamity howlers could be calmed, and if the army of Government scientists and publicity seekers, who spill so much ink in heralding new discoveries of old things, could be asphyxiated.

Many mine managers fool themselves as to their cost of mining. Many metallurgists are honestly deceived as to their percentage of metal extraction. Although we are pleased to think that we are saving 95 per cent. there seems always to be upward of 5 per cent. more to yield to improvements in the art.

Smeltery Smoke Agitation in California

SPECIAL CORRESPONDENCE

The agitation in the different school districts of Shasta county with reference to damage to farms, orchards, etc., by smeltery smoke, has resulted in the formation of the Shasta County Farmers' Protective Association. This new association has held a meeting at the town of Anderson and has decided to take a determined stand on the smoke question. A committee which had conferred with the smeltery managers at Coram, Kennett and Winthrop reported that these managers had made no definite promises of improvement, whereupon the following resolution was adopted:

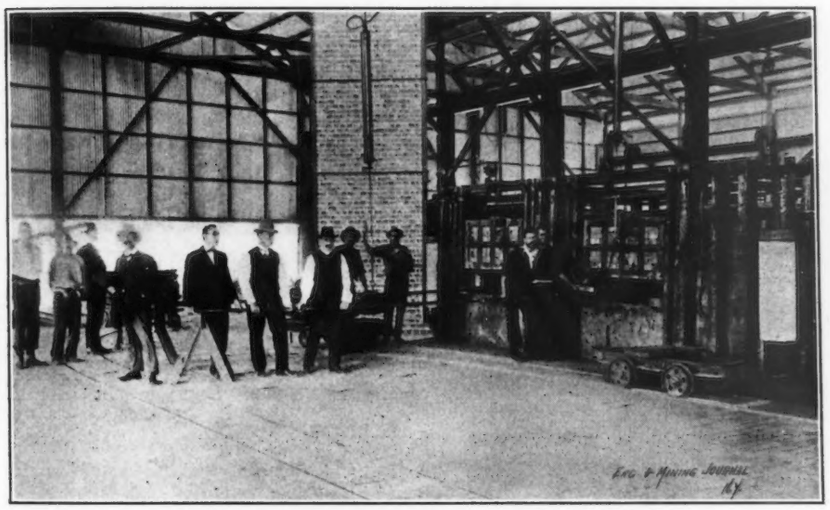
"That the Shasta County Farmers' Protective Association do hereby absolutely demand that the infliction of damages by smeltery smoke and fumes must cease. That said smelters be sent a copy of this resolution with the demand that, on or before Oct. 1, next, some tangible proof shall be submitted to this association that immediate steps are to be taken to stop said smoke and fume nuisance."

The smelting companies are already taking such remedial measures as seem best to them in this connection and have in numerous instances also obtained easements from farmers whose crops have been, or may be, damaged. Still further preventive measures will be taken if possible. The smelting industry of the county is now of the greatest importance and many millions of dollars have been invested in mines and plants.

Some years ago, when the agitation against the operations of the Mountain Copper Company, Ltd., at Keswick, began almost to amount to persecution that company closed down its smeltery and mine and built a new smeltery on the bay shore of Contra Costa county. The company was the largest tax-payer and largest employer of labor in the county and its cessation of operations was a severe blow to the mining and other industries of Shasta. Mine work was subsequently resumed and the ore shipped to the bay smeltery, all of which was bad for the county. Until these smelteries came into Shasta county, the mining industry languished, but their presence made a market for the ore the miners got out and started mines up in all directions. It would be a great blow now if affairs got into such a shape that the smelters had to close down even for a short time.

Copper Refining in Australia

B. Magnus, manager of the works of the Electrolytic Refining and Smelting Company of Australia, at Port Kembla, New South Wales, has sent us the accompanying photograph, which illustrates an historic event in the metallurgical industry of Australia, namely the inauguration of electrolytic copper refining in that Commonwealth. The engraving shows the first charge of blister copper being put into the anode furnace of these works by the Hon. C. G. Wade, the premier of New South Wales.



HON. C. G. WADE PLACING FIRST CHARGE IN FURNACE

Developments at the Dolcoath Mine

SPECIAL CORRESPONDENCE

The report for the six months, ended June 30, 1909, records a substantial improvement in the earnings of this Cornish mine as compared with the two previous half-years. This is mainly due to an increase in the grade of ore mined, the yield per long ton during the last six months, having risen to 48.85 lb. of black tin from an average of about 40 lb., at which the grade has stood during the last five years.

The development at the bottom of the mine has been of a satisfactory nature, two of the deeper winzes, or "winds," as the report gives it, having exposed ore of an average grade of 110 and 80 lb. respectively of black tin per ton of ore. The use of "winds" for the modern winze explains to some extent the origin of the word, though opinions differ whether the word was derived from the meaning of winding (hoisting) or from wind (ventilation). The use of this old-fashioned term is characteristic of Cornwall, which in methods of mining is far behind the times.

The new vertical shaft, called the Williams shaft, which in the future will be of much assistance in reducing the cost of working, has reached a depth of 2541 ft. from the surface, leaving 43 ft. to reach the 440-fathom level which is the depth measured on the incline from the deep adit. A crosscut has been driven from the 440-fathom level toward the shaft and at the date of the report there were only 25 fathoms more to drive to make this important connection.

The company has made a contract with a local electric power company for electric power for pumping, in which direction a considerable saving in costs may be expected. To meet the proposed increased production when the Williams shaft is put into commission, 12 heads of pneumatic stamps have been ordered and these, also, will be driven by electric power. Owing to the antiquity of the shafts, Dolcoath has hitherto been operated under great disadvantage and a considerable improvement in working costs may be looked for when the new equipment is in working order.

From the upper levels of the mine a considerable tonnage is being raised and when working on the larger scale, the mine may be expected to yield large quantities of ore hitherto unpayable but which under the altered conditions may be profitably handled. The bottom of the mine has been contributing about 28 per cent. of the tin stuff raised and 53 per cent. of the tin sold, which demonstrate the importance of the new developments.

For the half-year, the profit on 45,880 tons crushed was £14,827, which was reduced to £10,459 by deductions for income tax and depreciation. The dividend declared for the period absorbed £8500. Working costs averaged 26s. 10¼d. ($6.54) per ton, which is exclusive of 2s. 4d. per ton paid as royalty to the owners of the ground.

According to a recent British consular report, the export of copper from Japan in 1908 was 35,700 long tons against 31,800 in 1907.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice and Debatable Points Suggested by Articles in the Journal

CORRESPONDENCE AND DISCUSSION

The Vermont Copper Company

Being to some degree familiar with the copper properties at Strafford, Vt., I read with interest the article by Albert H. Fay, on the Vermont Copper Company, in the JOURNAL of Aug. 21, 1909. In stating that "between 1820 and 1830 at least 300 men were employed at the mines in the production of copperas," Mr. Fay was wrongly informed as to the period when the old Vermont Copperas Company was operating with great energy, for in the decade stated the enterprise seems to have been getting started and had attained no great importance. Among many other citations to the same import, the following sentences from an article by James Pierce, in the *American Journal of Arts and Sciences,* Vol. VIII, 1824, effectually disposes of the matter, viz.: "I passed a day at the copperas works in Strafford, Vt. Eleven men are employed, who calculated to make per annum 400 hogshead of copperas of 1500 weight each." Mr. Pierce's estimate indicates a yearly output of 300 tons of copperas, containing only 60 tons of iron.

However, thanks to the high price of copperas, the industry prospered and, though the bonanza period was long subsequent to the decade mentioned, was quite profitable during a considerable term of years, and handsome returns were made to the shareholders of the Copperas company. From an early day scrap iron was used to reduce the ferric sulphate and to precipitate such copper as might be in the copperas solution, and later when, with the gradual opening of the mine, it was found possible to pick out more or less copper ore of a fair grade, such selected ore was roasted and smelted. Still, although the contrary might be inferred from Mr. Fay's statement, the production of copper was never more than an incident to the manufacture of copperas during the whole period of operation of the Vermont Copperas Company's property. In this respect the Strafford property differed from those at Vershire and Corinth, which were worked solely for their copper contents.

The smelting of the selected ore was being carried on with some degree of success in 1837, when Isaac Tyson, Jr., of Baltimore, a prominent metallurgist, visited Strafford in a consulting capacity. He had evidently studied the orebody and, doubtless divining that it had a northerly rake along the footwall plane, which dipped to the east, had purchased in 1831 the adjoining lands to the north, although they did not show an ore outcrop. Many years later, in this land, the Tyson heirs developed the extension of the original orebody known as the Elizabeth mine. Excepting to the slight extent that the Copperas company's workings entered their neighbor's territory, the Elizabeth ore was not used for making copperas, as the profits thereon had disappeared before the Tyson property had been opened. However, attempts were made to select and smelt the ore and on the Elizabeth mine dumps there are about 50,000 tons of rejected ore, of which a large part must average: Copper, 1.75; iron, 40, and sulphur, 24 per cent. This rejected ore is in addition to the several thousand tons of heap-roasted ore mentioned by Mr. Fay as having laid in the roast yard for a number of years. The properties of both the Vermont Copperas and the Elizabeth companies are now held by the Vermont Copper Company.

Naturally, one's information does not extend to every stray shipment made from the property 50 years ago, but I am disposed to question the accuracy of the statement that, "about 1860 some of the oxidized surface ores were mined and sold for paint," for the erosive action of the glacier period in that section was most marked, and the sulphide ores on the Copperas company's property began practically at the grass roots along the whole extension of the outcrop, and there never was any oxidized ore on the property worthy of mention, so there was but a slight possibility of there being even a vestige of such ore remaining 67 years after mining was begun. The copperas produced was in part used in the manufacture of rouge and Venetian red, and I have heard of the experimental shipment of some lots of the old oxidized residuum from the leached and spent copperas ore, which may explain the statement.

What has preceded relates to the history of the consolidated property and, after all, to relatively trivial matters, but more important are Mr. Fay's statements respecting the ore and the manner in which it is to be worked. The gentleman continued: "An average analysis of the ore is as follows: Fe, 40; Al_2O_3, 6; Cu, 2 or 3; CaO and MgO, 2; and SiO_2, 15 to 20 per cent.; ⅓ of the silica is free and ⅔ is combined . . . . It is the intention to use the smaller (i.e., 8 ft.x44 in.) furnace experimentally on pyritic smelting . . . . No concentration of the ore will be attempted prior to smelting."

In my opinion, the reported analysis and statement that only one-third of the silica is free are unfair to the property. Unquestionably, in the southern portion of the Elizabeth workings, which was the only property in which any great quantity of ore was opened up in 1906, the ore is exceedingly ferruginous, in places running as high as 35 to 40 per cent. iron, but in the northern and deeper workings are less so, sometimes dropping to 16, 20 and 24 per cent., so that the general average of the mine is considerably under 40 per cent., as stated by Mr. Fay.

Neither limestone nor silicious flux, with any considerable amount of free silica, are convenient, nor are they to be had at reasonable prices, while the location of the property in northern New England, 10 miles from a railroad, makes coke expensive. In pyritic smelting the silicate gangue minerals simply dissolve in the ferrous silicate formed in the process and enter into the slag with their constitutions unaltered, so may here be neglected, especially in this case where the gangue minerals are singulo-silicates. The Elizabeth ore usually has about three units of iron as ferrous oxide in the biotite, which, with ore of the analysis stated by Mr. Fay, leaves 37 per cent. of iron in the sulphides, which must be oxidized and slagged with silica to produce metallic copper. It makes no difference in what steps the smelting may be carried on; the 6.67 per cent. of free silica (⅓ of 20 per cent.) the maximum amount stated by Mr. Fay, requires only 16 per cent. of ferrous oxide (12.4 per cent. Fe) to form 2 Fe O, SiO_2; leaving 24.6 per cent. iron to enter the matte. Then, unless an expensive silicious flux is used, the matte fall, in smelting ore of the analysis stated will be about 35 per cent of the weight and such matte will assay about 7 per cent. copper. It is manifest that a furnace concentration of this character would not be profitable.

But the ore is better than Mr. Fay states. In 1906, the Elizabeth mine was carefully sampled and the average copper contents was found to be 2.4 per cent. to 2.5 per cent. I, personally, had all the samples, more or less completely analyzed, but unfortunately have not the results by me. However, analysis No. 1 is a general sample made up of equal parts of the mine samples mentioned. Analysis No. 2 is of a lot of 60 tons from all parts of the mine in May, 1906. No. 3 is of a lot also mined in 1906. No. 4 is of a selected lot of 200 tons from a report by Prof. H. M. Howe.

ANALYSES OF ORE FROM ELIZABETH MINE.

	No. 1.	No. 2.	No. 3.	No. 4.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Cu	2.50	2.20	n.d.	5.01
Fe	32.15	34.50	32.20	30.19
Al_2O_3	7.43	8.10	7.70	8.97
CaO	1.70	2.40	2.60	1.68
MgO	2.72	n.d	n.d.	2.36
SiO_2	29.10	29.00	31.00	27.95
S	19.98	n.d.	n.d.	21.77

The sulphide minerals are chalcopyrite and pyrrhotite closely approximating the formula Fe_7S_8, while the gangue is almost entirely made up of the soda-lime feldspar, labradorite (Na_2O, 3 CaO, 4 Al_2O_3, 12 SiO_2); biotite mica (6 FeO, 2 K_2O, 2 MgO, 4 Al_2O_3, 11 SiO_2); the amber mica, phlogopite (K_2O, 6 MgO, Al_2O_3, 5 SiO_2) and quartz. The several gangue minerals, of course, occur in different proportions in different parts of the mine, but the ore represented by analysis No. 1 was a pretty fair general sample of the ore as it can be mined in large quantities, and apparently it was made up of the several minerals mentioned as shown in the accompanying table.

MINERALS IN NO. 1 SAMPLE.

		Fe	Cu	S	K_2O Na_2O	Al_2O_3	CaO	MgO	SiO_2
7.2	Chalcopyrite	2.20%	2.50%	2.52%	.....	.....	...	....	.....
44.3	Pyrrhotite	26.77	.....	17.48	.....	.....	...	....	.....
17.6	Biotite	3.18	.....	.....	1.75%	3.5%	...	0.91	6.25
8.2	Phlogopite	.....	.....	.....	1.04	1.7	...	2.66	3.33
7.3	Labradorite	.....	.....	.....	0.34	2.2	1.7	....	3.82
15.7	Quartz	.....	.....	.....	.....	.....	...	....	15.70
100.3		32.15	2.50	20.00	3.13	7.4	1.7	3.51	29.10

The feldspar and micas, being practically the only silicates present in any quantity in the ore, are all singulo-silicates, readily fusible in themselves and easily dissolved in ferrous silicate, so only the relative amounts of the iron of the sulphides and the free silica present need be considered. The iron of the sulphides requires 15.5 per cent. of free silica to form 2 Feo, SiO_2, which is just about the amount the table indicates is present, showing that ore of that composition is substantially self fluxing. As the other analyses indicate the same favorable condition, it must be acknowledged that the general proposition is decidedly more favorable than Mr. Fay's statement would indicate.

It should be understood that I am writing only respecting the problem and am not expressing an opinion as to the wisdom of the proposed method of treatment, which Mr. Fay informs us is admittedly experimental.

JOHN N. JUDSON.

35 Wall Street, New York, N. Y.
Aug 30, 1909.

There are nearly 2000 mining and quarrying enterprises in the State of New York.

Regulation of Gas in Mine Air Currents

I wish to call attention to the article on the "Regulation of Gas in Mine Air Currents" by John G. Smyth, published in the JOURNAL of July 3, 1909. Mr. Smyth states: (1) "The can is full of water when taken into the current and to take the sample both cocks are open," etc.; (2) "The flask full of water is connected with a hose to the can containing the sample," etc.

(1) When the air is sampled as stated in the article a part of its carbonic acid gas is lost in the water by absorption.

(2) When the air is transferred into the flask a portion of the remaining CO_2 again dissolves in the water.

We know that all gases dissolve to a greater or less extent in water and the solubility depends on the temperature and atmospheric pressure. According to W. A. Tilden, one volume of water will dissolve 1.7967 volumes of CO_2 at normal temperature and pressure. Since the quantity of CH_4 to be determined depends directly upon the observation of CO_2 after its combustion as stated by Mr. Smyth, the percentages of CO_2 and CH_4 as published in the article are much smaller than they actually exist in the mine air.

M. I. HACHITA.

Wilkes-Barre, Penn., July 28, 1909.

Sulphide Corporation

In the fourth paragraph of the article on "Sulphide Corporation," published in the JOURNAL of July 17, 1909, page 118, it is stated that in the plant owned by the Minerals Separation Company, the tailings treated for the half year ended June 30, 1908, amounted to 34,506 tons, producing 12,529 tons of concentrates.

This tonnage only represents the material treated in the plant on account of the Sulphide Corporation. The total tonnage passed through the plant for the period under review was 86,253 tons of tailings, producing 31,538 tons of concentrates, the difference between the two sets of figures representing material treated by the Minerals Separation, Limited.

SECRETARY, MINERALS SEPARATION, LIMITED.

London, E. C., Aug. 14, 1909.

The Assay of Cyanide Solutions for Gold Content

BY W. F. BOERICKE*

The following method has been used in actual practice and found to be quick, reliable and inexpensive, and requires no extraordinary skill in manipulation. As many as 30 or 40 samples may be run through in a couple of hours, and results check closely. In one case 12 samples were prepared for the assay furnace in 15 minutes.

The samples are sent to the assayer in wide-mouthed quart bottles, properly labeled. Four assay tons (118 c.c.) are withdrawn by means of a pipette, and run into a small pear-shaped Erlenmeyer flask; 10 c.c. of lead acetate are then added. A reaction follows, and the precipitate settles in a fine, cloudy heap. A few drops of 1 per cent. KCN are added, to make sure all the gold will subsequently precipitate. This might not happen if the solution were too weak. A few drops of silver nitrate (1.37 per cent.) are next added, if necessary to bring up the proportion of silver and cause the gold to part easily. Next a small amount of zinc dust (the amount covering a spatula point is sufficient) is added. This causes a black, muddy precipitate of the gold to form. The flask is then shaken and put on a hot plate and heated to boiling, after which 15 c.c. of HCl are cautiously added to dissolve the excess of zinc and make cupeling easier. The HCl need not be pure, the commercial acid being satisfactory. When cool, the solution is decanted and the precipitate washed. The spongy lead and gold remain in the bottom of the flask, and may easily be pressed together with the finger into a small, firm ball. This is wrapped in test lead and cupeled as usual.

The method is especially adapted to assaying zinc tails where the gold content is low. The lead acetate is added to collect the gold and give a larger button to assay. One great advantage of this method is that all the samples may be prepared simultaneously, as no step requires special attention.

A preliminary estimate of the gold production of the Transvaal for the year ended June 30, 1909, is given in the *So. Afr. Min. Journ.*, July 31, 1909. These figures show an output valued at £31,002,226 or an advance of £2,493,856 over that of the preceding year. During June an average of 2692.9 rock drills were in operation against 2260.2 during July, 1908. The number of men employed in the gold mines in June, 1909, was 19,561 whites and 172,579 colored, as compared with 16,504 whites and 158,664 colored in July, 1908.

*Cobalt, Ontario.

Details of Practical Mining

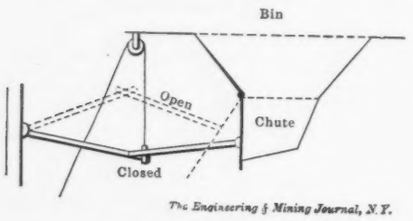
Notes of Interest to the Operators of Small Mines as Well as of Large Mines. The Things That Have to Be Done in Everyday Mining

REPORTS FROM EXPERIENCE

Readers of the JOURNAL are invited to contribute to this department. Articles should be brief, thoroughly practical, and preferably illustrated by drawings or sketches. Our draftsmen will prepare properly any kind of a pencil sketch that is intelligible. Something that is an old story in one district may be quite unknown in another. Articles accepted and published are suitably paid for.

Toggle-Joint Gate

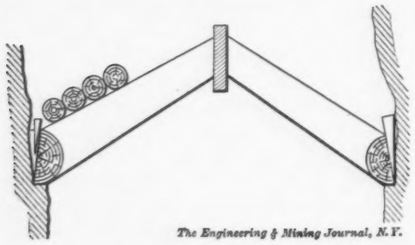
The accompanying illustration shows one type of gate for an ore chute as used by Witherbee, Sherman & Co., Mineville, N. Y. The gate itself is about 16x24 in. and the toggle-joint bars are ¾x3-in. steel, 3 ft. long. The gate has proved satisfactory. It is opened by means of a rope and pulley, while the weight of the bars is sufficient to close it.



TOGGLE-JOINT GATE

The Saddleback

The saddleback system of timbering, as shown by the accompanying sketch, consists of two ordinary stulls with their heads meeting upon the opposite sides of a 2-in. board. It is used occasionally where the drive or stope is too wide to allow the use of a single stull.



THE SADDLEBACK

Automatic Safety Clutches

As examples of the latest German practice, engineer Wintermeyer describes the following three devices in *der Bergbau*, July 29, 1909. In these, the aim has been to modify existing forms of such devices in use so that, with heavier loads and higher speed, the stoppage will be gradual instead of sudden.

HEILIG'S APPARATUS

In this device, as shown in Fig. 1, the bars *a a* are automatically pushed outward by the spring *b* when the cable breaks. The faces of *b b* are ridged and stand obliquely to the cross-beams *c c*. When these faces come into contact with *c c*, the bars are forced back and the spring *b* becomes compressed. In this manner the fall is checked. The cage falls to the next set of timbers and its velocity is further diminished. After a few such drops from timber to timber, there is not sufficient momentum remaining to force spring *b* back, and the cage remains suspended.

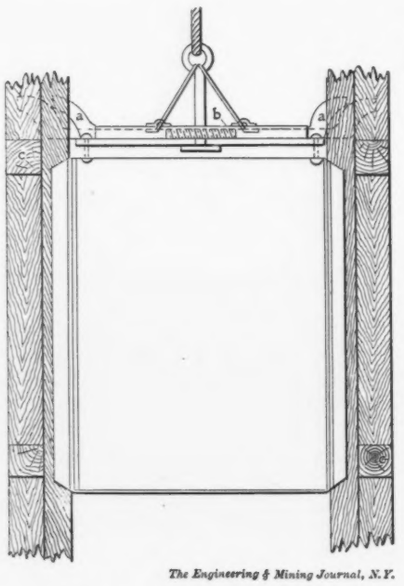


FIG. 1. HEILIG'S APPARATUS

LEH'S SAFETY CLUTCH

To the upper part of the cage (Fig. 2) are fastened two movable curved bars *b b* which are joined by the rods *c c* to the draw-bar *a* to which the cable is attached. The bars *d d* are pivoted at their bottom ends and are attached from their centers by rods *f f* to the lower crosshead of drawbar *a*.

Ordinarily the bars *b b* are drawn up by the cable pull until they pass freely up and down the shaft. If the cable breaks, the drawbar *a* is instantly pulled down by the spring, bars *b b* are forced out, *d d* are drawn down and snap into slots *e e* in *b b*. The bars *b b* are thus held apart and must wedge themselves between the shaft timbers *g g*. If the timbers *g g* should bend and let the cage fall farther, it will be held certainly at the next set. The bars *b b* cannot yield as they are braced by *d d* at their dangerous point.

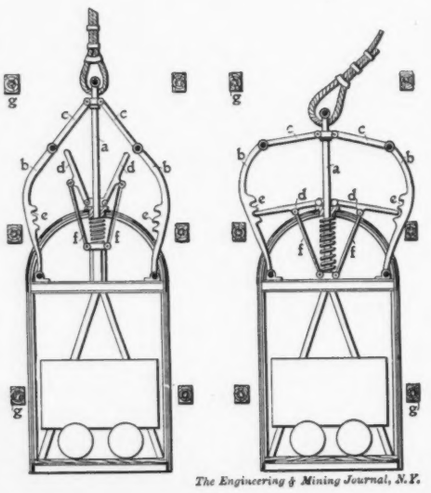


FIG. 2. LEH'S SAFETY CLUTCH

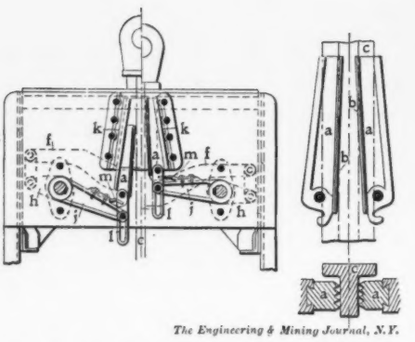


FIG. 3. DETAILS OF KEIL SAFETY CLUTCH

THE KEIL SAFETY CLUTCH

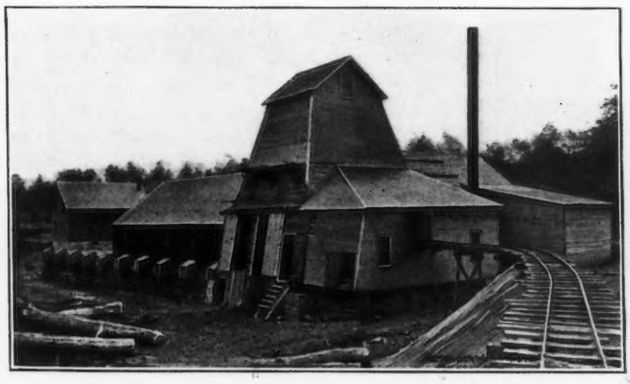
In Fig. 3 the wedges *a a* carry, on the sides next the guide rails, the ribs *b b* which extend along the whole length of

the wedges and have a toothed cross-section. These toothed ribs are not parallel to the guides but are arranged at a slight angle so that, when the cable breaks, the upper edges will penetrate the material of the guides to a depth of about 5 mm., and the lower edges about 1 mm.

The engagement of the teeth when the cable strain is removed is effected as follows: Bar *f* is actuated by a spring, depressing *h* and thus forcing *j* upward in the guides *k*. To enable the device to work on various sizes of guides, the hight of possible lift given to *a* is increased by the flat spring *m* and slot *l*. If *a* has been pushed to its fullest hight by the action of the spiral spring without gripping the guide, then it is still farther raised by *m* until the teeth take hold sufficiently to stop the cage.

Surface Plants over Mine Workings

A little foresight and thought concerning the location of surface buildings will often save thousands of dollars in later years. The accompanying illustrations show a plant that was erected on the very edge of an outcrop. So long as the ore is not removed, all is well. But the object of mining is to take out ore, and this is frequently done so near the surface as to endanger buildings. It is not always possible to tell, in the early stages of mining, just where the main underground workings will be. A thorough study of the problem should be made, and the buildings and shafts constructed on as safe ground as possible.



NO. 2 BUILDING AS ORIGINALLY ERECTED

NO. 2 BUILDING, AFTER CAVE-IN

Speed of Pelton Wheels

The article in the JOURNAL of Aug. 7, 1909, entitled "Housing a Pelton Wheel" calls to mind a costly mistake recently observed.

A certain mining company undertook to utilize the water issuing from its mine tunnel to run an air compressor for supplying air for the mine. It was estimated that from 25 to 30 cu.ft. of water were available per minute, with a head of 640 ft. By erecting storage tanks it was estimated that over 40 h.p. would be available during the time the compressor should be running. This would supply three drills.

NO. 1 BUILDING ON VERGE OF CAVE-IN. LOADING CHUTES OUT OF COMMISSION

UNSATISFACTORY RESULTS

For over a year this compressor gave unsatisfactory results. The work planned in the mine could not be done for want of air. After the expenditure of many thousands of dollars a hydroelectric plant was erected to bring sufficient power from a distance.

An examination of the former compressor showed where the trouble lay. The engineer who made the computations for its installation assumed that for maximum efficiency the wheel should travel at one-half the velocity of the water issuing from the nozzle. The pulleys were ordered accordingly, and when installed, the machine was found to run faster than had been calculated, except when the compressed air was over 100 lb. pressure. At that pressure the Pelton wheel ran at just about half the speed of the water striking it.

PROPER SPEED OF PELTON WHEEL

To get the maximum efficiency from a Pelton wheel it should travel a third as fast as the water striking it. In the case cited, if this ratio had been adopted the compressor would have pumped 40 per cent. more air when compressing air at 100 lb. and the efficiency would have been considerably more for lower pressures. This slight alteration in the size of the pulley on the wheel, from 8 to 14 in., would have been worth to this company about $10,000 during the year it was in commission and might, by saving them the expense of installing an electric plant, have saved the outlay of $15,000.

This ratio between the velocity of the water and of the wheel is not commonly known, and often the low efficiency of Pelton wheels is due to this lack of knowledge.

Grading a Drive or Tunnel

Metal miners, especially those working a property on a small scale, cling to the practice of laying rails by guess. The result of this is a drive that contains grades of all degrees of steepness, some of which often pitch in the wrong direction. All guesswork may be avoided by the use of a straight-edge, tapered to the required grade and fitted with a spirit level.

Suppose the grade desired is 1½ in. in 12 ft. The spirit level is fitted to the top of a 12-ft. straight-edge so as to parallel the bottom. Then the lower edge is cut so the new bottom will rise 1½ in. in the whole length. The forward end is marked in some manner. Thus, when the apparatus is laid along a rail or over the ties, the bubble will rest at center when the grade is correct.

Labor Efficiency in Mining Operations

By Peter B. Scotland*

In mining, as in all other industrial undertakings, economy of labor is an essential of success. It is of vital importance that a just and adequate return in labor should be obtained for the wages paid to the employees. In justice and equity the employer demands an honest day's work for a fair day's wage and failure to secure this return may turn the narrow margin of profit earned by many mines into a serious loss. No item of expenditure in mining is so expensive as labor and the reduction of this expense to the lowest figure compatible with equal fairness to employer and employee should be the aim of every mine manager. It is the purpose of this article to discuss some of the factors that contribute toward efficiency of labor.

Working Conditions

Working conditions, such as the system of mining employed, hand or machine drilling, ventilation, drainage and safety, have a great influence on the amount of work performed. It is the duty of the mine manager to have these influencing conditions as perfect as the mine will allow. A half drowned, half suffocated or wholly scared workman cannot do good work. Have each working place as good as it is possible to make it. Good tools, tram roads, rolling stock, shoveling floors and labor-saving devices are all factors that influence the results and therefore merit the most careful attention. These factors, however, are outside the scope of the present article. I shall confine my attention to the personal factor of efficiency and to the consideration of such means as shall aid in securing the best returns for the expenditure made.

Day's Pay and Contract Work

Between a "china boy" tapping a drill and a two-hundred-pound Butte slugger driving the same, there is a wide gulf in the amount of work done; so is there a wide divergence in the remuneration received. Eliminating the dictates of labor unions, the wages paid will depend upon the quality of the labor obtainable and the amount available. As the amount of remuneration is various, so also are the methods adopted of alloting this remuneration.

Broadly speaking there are two methods—day's pay and contract. Day's pay is the most common method employed in metal mining and the most unsatisfactory from the employer's standpoint. Little, in fact, can be said in its behalf except its simplicity and its favor in the eyes of the trade unions. It demands a large amount of supervision as the men have no incentive to work beyond the fear of losing their positions. Contract work is much to be preferred when permissible in a mining district. In it a workman has a direct interest in his work, as he is is paid by the results of his own labor and profits by his own extra exertions. It calls for less supervision and preserves a better feeling between the workman and his employer. In many mines part of the work is prosecuted on day's pay and part on contract, if this can be arranged, and such a combination is the most satisfactory method of conducting operations.

Low Efficiency

If we examine the labor conditions in many mines today, we shall find that the methods employed to secure results are very crude and would not be tolerated in most other branches of industry. A crew of miners, timbermen, muckers, etc., are under the supervision of the foreman and his shift bosses. It is the duty of these men to see that the work is carried on in a proper manner and they must in consequence be skilled miners themselves. In addition they must be observant and vigilant in order to detect any "soldiering" or shirking among the workers, and they must know by experience what constitutes a fair day's work. In most cases no record of the work performed is obtainable; the amount done depends largely on the watchfulness and "man power" of the bosses. Of course, there are many workmen sufficiently conscientious to give an employer full value for his day's wage without the mild coercion of a boss, but there are many less scrupulous.

The foreman selects and weeds out his crew to secure the best results. In many cases, however, this selection is largely made by personal likes and dislikes and not by any direct measure of the work done. This is soon detected by the men and has the detrimental effect of directing their efforts toward conciliating the man over them instead of doing useful work. The good worker is conscious that his exertions may be overlooked and the poor worker hopes to escape detec-

SEGREGATION OF LABOR.

.....Mine.

1909.	Miners.									Muckers.								
	Day's Pay.			Contract.						Day's Pay.			Contract.					
	Breaking Ore.	Break'g Waste.	Breaking Fill.	Breaking Ore.	Break'g Waste.	Breaking Fill.	Special Work.	Total Miners.	Efficiency Factor.(b)	Ore.	Waste.	Filling.	Ore.	Waste.	Filling.	Special Work.	Total Muckers.	Efficiency Factor.(b)
Average in May	7	1	2	12.6	..	..	..	22.6	14.8	2.3	..	6	18.5	..	..	..	26.8	13.9
June 1	7	1	3	13	..	..	..	24	16.5	2	..	6 (a)	19	..	..	..	27	15.7
June 2	7	1	3	13	..	..	..	24	16.8	3	..	5 (a)	19	..	..	..	27	15.2
June 3	8	..	4	13	..	..	..	25	15.2	2	..	6 (a)	18	..	..	..	26	16
June 4	7	..	4	9	..	..	..	20	19.5	2	..	6 (a)	16	..	..	..	24	17.3
June 5 (c)	7	..	3	13	..	..	..	23	13	3	..	4 (a)	17	..	..	..	24	13
June 6 (d)	7	..	4	8	..	..	..	19	17.7	2	..	5 (a)	16	..	..	..	23	14.7
June 7	7	..	3	13	..	..	..	23	15.7	2	..	5 (a)	19	..	..	..	26	15
Total shifts	50	2	24	82	..	..	..	158	....	16	..	37	124	..	..	..	177	....
Daily average	7.1	0.3	3.4	11.7	..	..	..	226	16.2	2.3	..	5.3	17.9	..	..	..	25.1	15.2

General.																			
Timber Men.	Helpers.	Ore Tramming.	Waste Tramming.	Ore Sorting.	Tool Dressers.	Nippers.	Track Men.	Tally Men.	Roustabouts.	Supervision.	Total Men.	Efficiency Factor.	Blacksmiths.	Carpenters.	Miners on Development.	Muckers on Development.	Grand Total Men	Tons Per Day.	Grand Efficiency Factor.
2	2	3.4	2	3	2	2	2	2	1	2	72.8	4	2	1	10	5	90.8	291	3.2
2	2	4	2 (a)	2	2	2	2	2	1	2	74	4.5	2	1	10	5	92	330	3.6
2	2	4	2 (a)	3	2	2	3	2	1	2	76	4.4	2	1	10	5	94	335	3.6
2	2	4	2 (a)	3	2	2	3	2	1	2	76	4.2	2	1	11	6	96	320	3.3
2	2	3	2 (a)	3	2	2	2	2	1	2	67	4.7	2	1	11	6	87	312	3.6
2	2	2	2 (a)	3	2	2	2	2	1	2	69	3.8	2	1	11	6	89	260	2.9
1	1	3	2 (a)	3	2	2	2	2	1	2	63	4.2	2	1	11	6	83	265	3.2
2	2	4	2 (a)	3	2	2	2	2	1	2	73	4.3	2	1	10	6	92	314	3.4
13	13	24	14	20	14	14	16	14	7	14	498	.....	14	7	74	40	633	2136	.....
1.9	1.9	3.4	2	2.9	2	2	2.3	2	1	2	71.1	4.3	2	1	10.6	5.7	90.5	305	3.4

(a) Filling stope 15. (b) Excludes waste and filling. (c) Trouble in stope 13. (d) Trouble in stope 13.

*Mine superintendent, Arizona Copper Company, Clifton, Ariz.

tion. Soon an average gait is arrived at which is only a little better than that of the poorest workman. A section-gang gait best describes it; it is a little heavier than exercise but not heavy enough for work.

Improved Efficiency

Along what line can changes be made to improve these conditions and what are the weak points of the present system? Managers in charge of large crews and responsible for large tonnages are apt to consider their men too much in the collective sense and not as individual units. It is this collective point of view that we must eradicate if we wish to secure better labor efficiency. It is necessary that each employee be considered, and be made aware that he is so considered, a separate individual unit from whom a certain amount of work is expected. Remove from his mind the idea that he is lost in the multiplicity of his fellow workmen or that their extra exertions will average up for his deficiences. Inculcate in his mind that he holds his position by his work and not by the whims of his superior. Let him understand that a shift's work must be given or he must make room for someone else.

These conditions may be idealistic but much can be done toward their attainment. It is of course impossible to propose a system that will be possible of universal application, but by modification to suit the different conditions the system here suggested may be applied with benefit. The principle advocated is to so arrange the work as to permit of the fullest data being obtained of individual performances, and to record the same in such a manner as to allow of daily scrutiny and comparison of results. Each day's work and each day's costs are to be considered as separate units, the causes for their fluctuations to be diagnosed and remedied.

These demands do not call for an army of book-keepers as might be supposed at first sight. A slight addition to the office force is all that will be required in most mines to obtain these data. With the system, however, the bosses will not have much time to think of their troubles or to ruminate on the iniquities of the foreman or the manager. It will keep their attention drawn to the work on hand and the necessity for securing results, and set them thinking how improvements can be made.

Labor Segregation Sheet

We wish to collect daily the data requisite to form a labor segregation sheet. To this end each boss is supplied with a printed card or a book which is a duplicate of the final sheet insofar as his men are concerned. These data are copied into the segregation sheet after each shift and in the presence of the boss responsible, and any changes of the crew or abnormal conditions affecting results are noted. The figures, to have any value, must be above suspicion and to insure this the labor totals and the tonnages must be constantly checked by the foreman and the timekeeper.

An extract from a monthly segregation, covering a period of seven days, will illustrate what is required and is almost self explanatory. The example chosen is that of a low-grade copper mine, worked from adit levels and supplying 300 tons of ore per day. The ground stands well and the ore is mined in ascending slices; waste filling from the surface is employed and little timber is used. The results of each day's work are collected from the reports of the shift bosses and tabulated, as shown in the accompanying specimen sheet.

This statement is full of information to the manager who knows his mine, and a daily scrutiny and comparison of results will keep him closely in touch with the work. Only the more important points to which his attention will be directed need be mentioned. It shows at a glance the number of men at work and any increase or decrease that may have occurred. The distribution of men on dead work and on productive work is easily seen. The most important figure of all is the efficiency factor showing the number of tons produced per man employed. This figure is bound to vary from day to day with the exigencies of mining but any fluctuations beyond reasonable limits call for immediate investigation. If the efficiency falls without any reason known to the manager, he will immediately localize the trouble by referring to the subsidiary reports of the mine bosses. The point of weakness discovered and no reasonable cause found, a word of warning to the particular gang will in most cases cause an improvement.

The men will soon realize that the complaint is founded on actual returns and not on mere surmise. They soon realize that an honest day's work is expected and if not given the fact is soon known and changes are in order.

Foremen and Under-Bosses

As it is impossible for the manager personally to supervise all the men in their work, he has usually to depend upon a foreman and his under-bosses to do so. The suitability and qualifications of these men for their duties is of vital importance in securing results. It is well nigh impossible to obtain men possessed of all the necessary qualifications and most managers have to make their bosses as Napoleon made his generals. Wide mining experience, a vigilant, observant disposition, and force of character are the most important qualifications.

It is not advisable to keep one man looking after the same part of the mine all the time; moving him around occasionally will help to keep his interest from flagging and have a good effect on the crew as well. After all is said, the best supervision will not produce the highest efficiency. There is no better system than contracting for accomplishing this end. The closer the supervision, however, the easier it will be found to introduce contracting, for the men will voluntarily seek the means of freeing themselves from sharing the blame of poor work with their less conscientious fellows.

Payments Based on Results

There are few places where it is not possible to devise some system of payment by results, and it will be found worth while to arrange the work with this end in view. Ore can be broken by the cubic yard or the ton, and mucking and tramming can be paid for by the car. Drifting, raising and sinking are conducted by contract in most mining districts. I have had good results by the payment of miners for the inch or foot drilled by hand or machine. The whole shift was occupied in drilling and after the shift left, a shot-firing crew in charge of a responsible man measured, loaded and fired the holes. As badly placed or unnecessary holes were not paid for, the miners were forced to use judgment in placing their shots.

The loading and tramming of ore can be contracted for provided an accurate record can be obtained. This may be secured by placing tally men at suitable positions; if the tally man is of a different nationality from the rest of the crew, the returns can be relied upon. Chinamen have been found very successful in this capacity in many places.

It is not advisable to let contracts wherein one man employs a large number of others. Small contracts, where each man has an interest, are preferable. It goes without saying that the subletting of contracts is not to be tolerated. It is generally taken for granted that contracting in metal mines is impracticable, but a trial will convince the most skeptical that it is not only possible but that great economies can be obtained by its use.

A recent discovery of tungsten ore in the Moose River gold-mining district in Nova Scotia shows, so far as exploration has gone, a well defined vein composed of scheelite, quartz and a little mispickel. The vein matter is very irregular in composition, varying from pure scheelite to pure quartz or pure mispickel and all combinations of these three.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Robert Schorr, of San Francisco, is in the East on professional business.

Marion L. Thomas, of the City of Mexico, has been visiting New York.

W. H. Shockley has gone to Sobolinnaya, Siberia, to examine the Kluchi gold mines.

Col. Donald McGregor, a pioneer explorer of Yukon Territory, was in Toronto recently.

Robert Linton, of Atwater, Linton & Atwater, has been examining iron properties in east Texas.

Etienne Ritter has been examining mines in the Little Smoky mining district, Blaine county, Idaho.

Prof. J. C. Gwillim, of the school of mining, Kingston, Ontario, is on a vacation at Vancouver, B. C.

F. A. Thomson, professor of mining at the State college, Pullman, Wash., was in Victoria, B. C., for two or three weeks during August.

Chicago subscribers are notified that the streets of Chicago have been renumbered. We request that they send us their old and new addresses.

Gen. O. H. Ernst, E. E. Haskell and W. E. Wilson, American members of the International Deep Waterways Commission, are in Toronto.

F. B. F. Rhodes has accepted the position of night superintendent of the Perth Amboy plant of the American Smelting and Refining Company.

Thomas Kiddie, of Northport, Wash., was in the Nicola valley district last month. He went thence to Texada island, also in British Columbia.

Frederic Keffer, the British Columbia Copper Company's mining engineer, has been looking over some mining properties in the Coast district of British Columbia.

Lewis Stockett, general manager of the Bankhead Mines, Ltd., has returned to Bankhead, near Banff, Alberta, after having spent a week on Vancouver island, B. C.

Frank C. Loving, of Toronto, Canada, has fully recovered from the illness that has incapacitated him for the past three months, and is again engaged in professional work.

Corey C. Brayton, for five years past with the Guggenheim interests, in charge of various mines in Missouri, California and Mexico, has resigned and has opened offices in the Cheuic building, Montgomery and California streets, San Francisco.

A. B. W. Hodges, manager of the Granby Consolidated Mining, Smelting and Power Company, Grand Forks, B. C., recently visited several mining camps on Moresby island, of the Queen Charlotte group, in the northern coast of British Columbia.

R. C. Buxton has retired from the active management of the coal mines of the Consolidated Coal Company at Buxton and Ockaloosa, Iowa, and will have general offices in Chicago. Elmer Baysour, recently of Spring Valley, Ill., will have charge of the Buxton mines.

Societies and Technical Schools

Colorado School of Mines—Thomas F. Walsh has given this school, at Golden, $5000 to be used as a special fund to be expended in testing pitchblende and other uranium ores found in Colorado, which may be supposed to contain radium. The school will carry on tests of all such ores which may be sent to it.

University of Kentucky—In this institution at Lexington, the College of Mining Engineering offers three courses in mining: (1) The full course, which extends through four years. (2) A two years' course for young men who for any reason may not be prepared to take the full course, but who desire to obtain more than an elementary training in the methods of mining. (3) A short course for practical miners, mine foremen, and mine managers who desire to improve their knowledge of the principles that underlie correct mining. This course, which covers a term of 10 weeks, is necessarily given in the spring or summer. In 1907-'08 the university authorities erected a commodious mining laboratory. The building is of brick, 40x80 ft., and two stories high. The first floor is used for instruction in ore dressing and metallurgy; the upper one for assaying and metallurgy. Space is provided on the first floor for the clay-testing kilns of the State Geological Survey, and the chemical laboratory of the Survey occupies part of the second floor. This building constitutes a wing of a building, which will contain classrooms, drawing rooms, offices, etc., for the college, and offices and rooms for records, books, etc., of the State Inspector of Mines and the Geological Survey, together with the State Geological Museum.

American Institute of Electrical Engineers—The Western Electric Company has presented to the library of the American Institute of Electrical Engineers a most valuable addition in the shape of a patent specification library. This gift constitutes the largest accession since the original creation of the library by Dr. S. S. Wheeler with the Latimer-Clark collection. The patent library which the Institute thus acquires contains no fewer than 461 substantial leather-bound volumes containing approximately 100,000 specifications. These specifications begin with May 30, 1871, and run to December, 1908, thus covering the entire period of activity which includes the telephone, the electric light, electric railways and the electric motor. From May 30, 1871, up to the last day of 1887 the volumes are complete, containing all the specifications issued by the patent department, certified. From July, 1887, up to Dec. 1, 1908, the volumes contain all the electrical specifications which are not certified. It is generally believed that this splendid contribution will prove one of the most valuable accessions that the library could possibly have from the standpoint of practical utility, and that it will be likely to stimulate further generosity of the same kind. It is a most fortunate coincidence that the Institute had already been presented with a set of specifications antedating the period prior to those included in this gift.

At Great Falls, after years of experiment to determine the shape of converter which is most economical, the Great Falls engineers have decided to adopt the circular section, 12 ft. in diameter with 15 convergent tuyeres. This is the fourth type which has been used. The first was of circular section, 7 ft. in diameter, with eight convergent tuyeres. The second, of elliptical section, 10 and 8 ft. at the axes, had 12 tuyeres arranged in two opposite rows without any convergence of tuyere mouths.

It was found that the trunnion sides of the lining wore rapidly, where the width was the shorter (8 ft.). Accordingly, the third type, with a width of 10 ft. on the tuyeres section, and 12 ft. in the trunnion section, was used. This had 15 convergent tuyeres. This type has now been replaced by the first described, of circular section and with 15 tuyeres. The converter lining is composed of second-class concentrates and copper precipitate from the electrolytic refinery, with 10 per cent. of sand. The mixture analyzes: Al_2O_3, 12; SiO_2, 57-70; Cu, 3½-6; FeO, 5-6 per cent.

Among the notable engineering enterprises completed this year in Colorado is the Gunnison tunnel, 6 miles in length, built by the United States Reclamation Service. The gates which divert the waters of the Gunnison river into the tunnel will be opened by President Taft on Sept. 22. The bore is 11x12 ft. inside measurement, lined with cement throughout, its capacity being 1300 cu.ft. of water per second, and it is estimated will furnish water and electric power and light for 25,000 people. The charge for perpetual water right will be $35 per acre, based on the actual cost of the tunnel. The time occupied in construction was four and one-half years.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Butte, Denver, Salt Lake City, Goldfield, Cobalt and Toronto

REVIEWS OF IMPORTANT EVENTS

San Francisco

Sept. 1—The finding of a new ledge in the famous old Idaho mine at Grass Valley, Nevada county, now part of the Idaho-Maryland Mining Company, is the most important thing which has happened in that quartz-mining county for some time. The rich oreshoot or chimney, which started in the Eureka, ran into the Idaho and then into the Maryland ground and yielded upward of $16,500,000. When the ledge began running from the Idaho into the Maryland ground the workings were at such a distance from the mouth of the crooked shaft that the cost of mining was very great. For some years the property was idle and then a company was formed to work it. Work has gone on with more or less regularity and success, trying to find paying ore. The new ledge now found on the 400 level is from 12 to 16 ft. in width, filled with sulphurets and showing some free gold.

This body was found by following a small seam 55 ft. back from the old 500 level and a raise was made to the 400. The main oreshoot is expected to be encountered shortly, paralleling the rich old chimney but some distance back of it. Chutes have been put through down to the 700 level in anticipation of the pay shoot continuing downward. It will, however, pass beyond the end of any of the levels ever run by the old company and give much virgin ground. Twenty stamps are dropping on ore and soon 30 will be running. It is fully expected by the owners that the Idaho will soon resume its position as a large producing mine.

Efforts are being made in this city to have a large delegation go in a special train to the meeting of the American Mining Congress at Goldfield, Nev., in September. Not only mining but commercial men are becoming interested. San Francisco has been largely benefited for years by the output of Nevada mines and more San Francisco men would interest themselves in that State if they would but go and see what is being done in its most productive camp.

The auto service between Nevada City and Alleghany and other Sierra county points seems to show that these lines will be successful in the mountain regions of this State, as well as in the desert regions of Nevada. The auto service between Redding, Shasta county, and Weaverville, Trinity county, has also done well, though the road is very mountainous. The quick transportation afforded is welcomed by all those having business at the mining camps in the higher mountain counties.

Creditors of the Ruth Pierce Mining Company, operating the Grimshew mine at Hornitos, Mariposa county, have asked the courts that it be declared an involuntary bankrupt. The company acknowledged, May 18, that it could not pay its debts. Among the creditors are the Union Oil Company, the Fulton Iron Works and Pacific Hardware and Steel Company.

Butte

Sept. 2—Following persistent rumors that mining litigation would soon be started involving the ownership of certain orebodies claimed by the Amalgamated, the first of what may be a series of actions was begun a few days ago. The title of the case is W. O. Clymo and Sampson Hoar against the Anaconda Copper Mining Company and the First National Bank of Butte. The suit involves the ownership of certain orebodies in the Ticon quartz claim, which comprises an area of about two acres, and is situated north of the Bell-Speculator claim, between the latter and the Edith May claim. The Bell-Speculator claim was originally a portion of the old Speculator and was given to the Anaconda company in the settlement of a dispute between that company and the Largey estate, the former owners of the Speculator.

The complaint alleges that the plaintiffs, Clymo & Hoar, are lessees of the Ticon claim under a lease given them in 1907 by Silas F. King and that while working the mine they extracted certain ore of the value of $966. The ore was sent to the Pittsmont smelter for treatment and while there the Anaconda company made the claim that it was entitled to the proceeds since the ore was taken from one of its veins. It was then agreed that the proceeds be placed in the First National bank to await the settlement of the dispute. While the amount involved is relatively small, the real object of the action is to determine the ownership of orebodies of great value, since the ledge over which the dispute has arisen is supposed to be a portion of the Edith May vein, the greater portion of which is claimed by the North Butte company.

The Ticon is developed to a depth of 500 ft. Should the plaintiffs succeed, the outcome will undoubtedly be an action by the plaintiffs against the North Butte company to determine the ownership of orebodies now claimed by the latter. The action is generally regarded as the most important mining litigation that has been commenced in the Butte district since the days of the Heinze-Amalgamated troubles.

Governor Norris has named the following as the Montana delegates to the American Mining Congress to be held at Goldfield, beginning Sept. 27: Arthur Carson, Lee Mantle, Thomas Bryant, J. G. Morony, Harry Gallway, T. S. Kilgallon, S. A. Rohn, all of Butte; Owen Byrnes and John Edgerton, of Helena; C. E. Morris, of Pony; M. L. Hewitt, of Corbin; Peter Mussigbrod, of Deer Lodge; J. R. Lucas, of Phillipsburg, and Thomas Ross, of Argenta.

Denver

Sept. 3—The historic Argo smeltery the property of the Boston & Colorado Smelting Company, in this city, is to be closed down. Various reasons are given: scarcity of proper ores and fluxes, high railroad rates, etc. However, as generally understood, at one time Denver was the great smelting center of the State, and Argo was without a rival, but gradually as the various camps developed and new metallurgical methods were discovered, local reduction works and concentration mills were established, and the ore supply in this way so diverted that to run the Argo smeltery became unprofitable. The tall smokeless stack of the old Grant works and now those of the Argo, serve to remind mining men of the passing of Denver's glory as a great smelting center. The Boston & Colorado company was organized by Nathaniel P. Hill in 1867, with a full-paid capital of $275,000. Experimental works were then built, and with Herman Beeger as metallurgist, blew in during January, 1868. At first, the product was wagoned to the Missouri river, and thence conveyed to Vivian & Sons, Swansea, to be refined. In 1873, the capital was increased to $500,000, and in 1878 the smeltery was moved to the suburb of Argo, and the services of Dr. Richard Pearce, who had much previous experience in the Swansea works, were secured, and refining works were erected, which, under his direction, successfully produced the metals of gold, silver and copper until a few years ago, when he retired and went back to Cornwall. Since then the business has steadily declined, chiefly for reasons given, until the present shutdown became necessary.

The Modern smeltery, of 350-ton capacity, at Utah Junction on the Moffat

road, is advertised to blow in next week. One of the local papers goes so far as to say "there is not another smeltery like it in this hemisphere." We shall see.

In the Cripple Creek district, the output for August is given at 63,330 tons, of a gross value of $1,346,814. This shows an increase over July of 4320 tons. The Doctor-Jack Pot Company has just paid a $15,000 dividend. For the year ended June 1, the company received over $8000 in royalties from leasers, and has $52,633 in the treasury. The mines belonging to the Stratton estate, comprising about 200 acres on the richest portion of Bull hill, and 600 acres on Gold hill, are being worked entirely under lease, and shipping about 100 tons per diem. Of course, no development is being done ahead of extraction, but there are immense possibilities in this group, and negotiations are under way for a sale of the property. It is said that the trustees are anxious to clear up everything, and devote their energy and money to the projected Myron Stratton Home for the Aged and Infirm, for which Stratton left the entire estate.

Goldfield

Sept. 2—Fifteen tons of specimen ore was received by the classifier of the American Mining Congress as one day's receipt during the past week. Many more specimens are on the way, and when the exhibit is completed it will be one of the best ever shown. The collection of Mrs. Helen M. Sneider, of Austin, Nev., comprising over 3700 specimens, which have been exhibited at a number of the principal expositions of Europe, will be one of the important exhibits.

The report of the Florence-Goldfield Mining Company for July gives some interesting figures regarding the recovery in the various departments of the mill. During the month 2919 tons of an average value of $26.66 were treated, the total bullion recovered being valued at $70,706, or a 91.09 per cent. recovery divided as follows: By amalgamation, 14.2; by concentration, 55.79; by cyanidation, 21.1 per cent. The average total cost of mining and milling is placed at $8 per ton, the mining cost being high on account of the extensive development under way. The milling cost is approximately $3.50 per ton, and is expected to be reduced when the mill is working at full capacity.

Salt Lake City

Sept. 3—The delegates to the meeting of the American Institute of Mining Engineers in Spokane, Sept. 27-30, have arranged to spend four days in Salt Lake and the surrounding mining camps on their return from the convention. A local committee is busy arranging a schedule of entertainment for the engineers during their stay here, which will include visits to the Bingham, Tintic and Park City mining districts and to the big smelteries and mills at Garfield, Bingham Junction and Murray.

The aërial tramway of the Utah Consolidated company, which will run from Bingham to the new Tooele smelter, is progressing rapidly and will be in commission before the completion of the smeltery. The foundation of the loading station at the mine has been finished and the concrete work at the base of most of the towers is ready for the superstructure.

Local mining men agree that the Park City mining district is on the verge of an era of great prosperity. During the last few years, the camp has suffered from low metal prices, the blocking of the Ontario drain tunnel and other untoward incidents but several big combinations of the smaller mines are putting new life into the camp, and the old producers, the Silver King Coalition, the Daly-West, and the Daly-Judge are still opening up new resources.

Dr. Benzo Katsuro, professor of metallurgy in the Tokio Imperial University, spent the last week at Bingham and other Utah camps. The purpose of his visit is to obtain more information concerning our methods of mining and treating ores.

The workings on the extension of the Colorado-Sioux vein in the Iron Blossom mine in the Tintic district have for some time been in ore of lower grade than was being mined when the 8c. dividend rate was established and there has recently been much discussion as to the dividend rate the mine would be able to maintain. Recently, offers have been made to take 5c. per share for the September dividend. A mining engineer who recently visited the mine reported that the ore was low-grade but of considerable quantity.

Ishpeming, Michigan

Sept. 2—Practically all the mines in this district are in operation, and the outlook for a large production of ore is good. Much new work is being done in the Swanzy district, southeast of Ishpeming. The Cleveland Cliffs Iron Company is spending a large amount of money in development work. On the Kidder property a concrete shaft has been sunk through quicksand to solid rock at a depth of 114 ft. The Smith shaft is only a short distance from the Kidder; it is now 720 ft. deep and will be connected with the Kidder shaft by drifts. When the drift from the third level of the Smith shaft reaches the Kidder shaft, a raise will be made to the present bottom of the Kidder. The shaft will then be sunk full size by sending all the dirt through the raise and hoisting at the Smith shaft. All the hoisting so far at the latter shaft has been with a derrick and boom. A steel head frame is to be built soon at the Northwestern property. A concrete shaft has been started and is down 40 ft. Work has been stopped on account of litigation.

Within about one mile of these shafts the company has laid out the town of Gwinn, covering an area of 118 acres. Good broad streets have been graded and paved; the lots are large and will be sold only under certain building restrictions, which govern the character of the house to be built. A large brick school house has been completed; several substantial business blocks have been built and a club house is now under construction. Everything is being done to make this a model mining town.

About one mile west of the townsite, the Princeton, Austin and Stephenson mines are producing ore and making regular shipments. The district promises to be one of considerable importance in the iron-mining industry. Most of the ore is soft, and the slicing and caving system of mining will be the principal methods used.

Cobalt

Sept. 2—At the Imperial Crown property, which is controlled by the Crown Reserve, a force of men is engaged in thoroughly trenching the surface. The whole territory is being cut into 100-ft. squares, and several promising calcite veins carrying some silver have been discovered. On one of these veins a shaft is being sunk, and it has now reached a depth of 36 ft. Another shaft is soon to be started on a vein near the Kerr Lake-Majestic line. A diamond drill is working to locate the underlying Huronian slates. On the 200-ft. level of the Crown Reserve, the east and west winzes have been connected by a drift. The 200-ft level is all in the Keewatin, and the veins do not show very much change in silver content. They are, however, much more split up. It is expected that the main shaft will reach the 200-ft. level in about a month.

The North Cobalt mine has struck a large vein carrying fair silver content on the 170-ft. level. This company started operations in 1907 and sunk on a small calcite vein, carrying practically no silver. The results were considered unfavorable, and work was discontinued until the Jacobs Exploration Company took a working option and obtained control. A compressor was installed, and work was continued. When the shaft was down 182 ft. a crosscut from the 170-ft. level was started, and when in 40 ft. the vein was struck.

Development on the new No. 12 vein found on the Lawson is very encouraging. It has been stripped for over 175 ft., and the vein shows a good width of high-grade ore. The shaft sunk on the vein in the Keewatin is down about 45 ft., and the vein widened from about 1 in. to nearly 5 in. of high-grade ore. The wall rock is also well mineralized. Another new vein has been discovered on the Foster at a point about 300 ft. north of where the first strike was made. The

new vein has been opened up for about 20 ft. and shows about 3 in. of smaltite, with high silver content.

Toronto

Sept. 3—The Canadian government has appointed a commission for the conservation of national resources to coöperate with the American commission. It is a large and thoroughly representative body. Hon. Clifford Sifton is named as chairman and administrative head and the following are *ex-officio* members: Hon. Sydney Fisher, Hon. Frank Oliver and Hon. William Templeman, of the Canadian cabinet; Hon. Francis L. Hazzard, premier of Prince Edward island; Hon. W. T. Pipes, attorney-general of Nova Scotia; Hon. W. C. H. Grimmer, surveyor-general, New. Brunswick; Hon. Jules Allard,, minister of lands and forests, Quebec; Hon. Frank Cochrane, minister of lands, forests and mines, Ontario; Hon. Hugh Armstrong, provincial treasurer, Manitoba; Hon. James A. Calder, provincial treasurer, Saskatchewan; Hon. A. C. Rutherford, premier, Alberta; and Hon. F. J. Fulton, commissioner of lands, British Columbia. There are 20 other members, including a representative of each Canadian university. The annual meeting is fixed for January, but the chairman will have power to call the commission together at any time.

F. A. Acland, deputy minister of labor, has gone to Glace Bay, Nova Scotia, to investigate and report to the department on the Dominion Coal Company strike.

The Dominion Iron and Steel Company has declared a dividend of 7 per cent. on preferred stock, to be paid out of earnings, as no settlement has been obtained with the Dominion Coal Company of the amount still due from the latter. Negotiations are in abeyance owing to the coal strike. After the dividend has been paid there will yet remain 28 per cent. in deferred dividends on the preferred stock. Work is well under way on extensions at the plant. The deficiency in the supply of coal from the Dominion Coal Company is made up by purchases from other Nova Scotia collieries and from the United States. American coal is being brought in much more cheaply than before the dispute with the Coal company. The cost laid down at Sydney is stated to be under $2.75 per ton.

Mexico

Sept. 1—The recent floods in northern Mexico have done vast damage to the railroads of the states of Nuevo Leon and Coahuila suspending all traffic for weeks in some cases. At Monterey, the overflow from the Santa Caterina river caused a large damage to the city and resulted in a loss of life reported between 3000 and 4000. Several of the important mining camps of the north have been entirely cut off by the disaster and operations curtailed or suspended. The coal-mining companies are the heaviest losers in this respect and the failure to deliver coal has hampered mining operations throughout the whole northern and central part of the Republic.

The John Taylor & Sons interests, of London, are negotiating for important properties in the Sierra Juarez district of Oaxaca. William Crossley, of Chihuahua, is the examining engineer in the negotiations. This firm was one of the largest of the English interests in Mexico from 1825 to 1850 but until recently has not been actually interested in the field.

A. B. Adams has returned from Europe and reports that capital has been secured in England and France to carry out the ambitious plans for the development of the coal and iron deposits in northern Oaxaca and for the building of a railroad from Puebla to the coal and iron district with an ultimate extension to the Pacific. J. W. L. Birkinbine, of Philadelphia, is in charge of the explorations for the company.

The interest of American investors in Mexican lands continues to increase, and there is a prospect that the American investments in lands in Mexico may in a few years exceed the American mining investments. The advent of the American land owner is considered as a favorable feature by the mining interests, as it means the development of roads and commercial facilities in many districts. In some districts the agricultural development interferes with the mining by creating a demand for labor in excess of the supply, but generally the coming of the American farmer is favorably looked upon by mining interests.

London

Aug. 27—This is now the holiday season and business in mining shares or in new ventures is practically at a standstill. As regards South Africans, one or two new amalgamations have been announced and the terms have been advertised upon which the Transvaal government is prepared to grant leases of some of the mining ground that it owns in the eastern Rand. The principle upon which these leases is founded is that the lessee shall find the working capital and pay over a certain percentage of the profits to the government. It remains to be seen whether the leading operators of the Rand who are the only people who have the experience and the funds for handling the business on the lines proposed, will think it worth while to make an offer. Having regard to the large sums involved and the risks of the venture being successful, as well as to the expected shortage of native labor, it seems doubtful whether the offer of the Transvaal government will meet with any response.

In the Rhodesian section there has been a substantial rise in the shares of the Globe & Phoenix, one of the oldest mines of the country. A few months since, the shares were selling at 20s. and this week they have changed hands at over 80s., due to rumors of favorable developments at the bottom of the mine. Nothing official, however, has yet been published.

Johannesburg

Aug. 2—The issue of the chamber of mines' analysis of the June mineral production of the Transvaal contains an interesting statement of the results achieved to date on the Witwatersrand. This is in the form of a table going back three years before the war, but omitting 1899, as the figures for that period are incomplete. The working costs per ton milled are taken as the difference between the declared output and the dividends announced, which brings out last year's costs at just over 22s. 3d. ($5.41), whereas the actual working costs given in the chamber of mines report for last year were 18s. ($4.37). Though the working costs per ton milled are an unsatisfactory, and in many cases, totally misleading index of efficiency, yet they afford a good idea of the progress of the industry as a whole.

For the first half of this year, the difference between yield and distributed profit amounted to £10,419,243, or 20s. 7d. ($4.89) per ton, but the actual amount expended on the mines is shown by the report to have been £8,757,459, or 17s. 4d. ($4.21) per ton. This method, however, is not so applicable to a half-yearly return, as many of the companies do not pay dividends for the first six months proportionate to those of the whole 12, and some even declare after the six months has expired.

One striking feature of the table is the rapid increase of the tonnage milled. From 4,000,000 odd tons in 1896, it advanced to over 18,000,000 in 1908, while during the first half of this year the companies crushed over 10,000,000 tons.

For the first five years embraced by the table the yield was approximately 40s. ($9.73) per ton, but the working costs were in the neighborhood of 30s. ($7.30) per ton. In 1902 there was a slight improvement in grade, accompanied by higher working costs, but this was due to the fact that only the richer mines had again got to work. From then the decrease in grade has been persistent, being most marked in 1903, 1905 and 1908. But this has been accompanied by a proportional decrease in operating expenses, not perhaps in the same year, but immediately afterward.

It looks as if the Rand this year will crush close to 21,000,000 tons of ore, will produce nearer £31,000,000 than £30,000,000 worth of gold and pay dividends within a few hundred thousands of the 10 millions sterling.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

General Mining News

American Smelting and Refining—At the annual meeting of the company, held in Jersey City last week, the retiring directors and officers were reëlected. The usual quarterly dividends of 1 per cent. on the common and 1¾ per cent. on the preferred stock were declared.

Alaska

Nome—The ammonia freezing process has proven successful in stopping the flooding of the Cyrus Noble mine. At the Nettie and Bessie mines recently the subterranean geysers were temporarily checked, which had the effect of furthering the two-mile drainage tunnel. The dry season is retarding mining all over the peninsula, many companies having ceased operations because of lack of water. If no rainfall occurs in the next few weeks the season will have been practically a loss to the entire district.

Fairbanks—The group of five claims owned by L. L. James is the largest producer in this camp. Last year, the property yielded $400,000 gross, and is doing fully as well this season.

Arizona

COCHISE COUNTY

Calumet & Arizona—During the installation of the new electric hoist at the Irish Mag shaft, retimbering of the shaft has been in progress and ore will be raised through the Oliver. The enlarging of the smeltery at Douglas to a daily capacity of 3000 tons is proceeding steadily. Two of the six 300-ton furnaces have already been increased to 500 tons capacity and work is now under way on the enlargement of the third furnace.

Denn-Arizona—Sinking has been started from the 1250-ft. level and is to be continued to 1500 ft., the management being much encouraged by the important strikes recently made on the 1250 level.

Superior & Pittsburg—Development of the sulphide orebody on the 1500 level from the Junction shaft continues with satisfactory results. This is the deepest ore that has been opened in this section of the Warren district. August production was approximately the same as during the previous month.

Copper Queen—Near the Czar shaft, the precipitation tower which collapsed recently has been rebuilt and put into service.

GILA COUNTY

Warrior—An option on this group has been asked for by Henry B. Hovland, representing Duluth, Minn., interests. The stockholders will act upon the proposal at a meeting to be held the latter part of the month. The mine is outputting about 100 tons of smelting ore daily from development work.

PINAL COUNTY

Ray Consolidated—In order to take advantage of the right of stockholders to subscribe for the new stock at $15 per share, over $2,600,000 of the $3,000,000 bond issue has been converted into stock, practically relieving the company of interest charges during the period of construction. From the new stock issue the company will have cash assets of between $4,000,000 and $5,000,000. Eight carloads of rails for the broad-gage railroad to the property were recently received.

Gila—It is now estimated that there are between 6,000,000 and 7,000,000 tons of ore, fully and partially developed. The orebody is situated somewhat deeper and is a little thicker than that of the Ray Consolidated, but as the surface is higher the ore is on about the same horizon and both bodies can be mined by a continuous line of workings.

California

BUTTE COUNTY

Martha Washington—At the property, near Kimshew, controlled by W. P. Lynch, rich gravel has been struck.

CALAVERAS COUNTY

Reiner—This company, owning about 600 acres of ancient river channel, near Angels, has made extensive improvements and is now ready to begin operations as soon as the electric power line is connected.

EL DORADO COUNTY

Red Horse—At the mine, near Rescue, Pottle & Blake have been taking out very rich ore, which is being hand-mortared and panned.

HUMBOLDT COUNTY

California Mining and Dredging Syndicate—After a successful run on Tennessee flat the company has closed down for the season. Preparations are now being made for the winter run. Fred T. Hale, Orleans, superintendent.

Klamath River Mining Company—The company is now equipping its hydraulic mine near Weitchpec and building a V-flume from Hopkins creek, a distance of 3½ miles.

Tinsley & Hudson—These men have sold 220 acres of mining ground to A. C. Cruchet and associates, of Boston, and the new owners are equipping the property for hydraulicking.

INYO COUNTY

Chicago District—King Brothers have started their mill on ore from the Unthanks lease on the St. Ives at this camp. The ledge is narrow, but the ore is of high grade. The mines are 20 miles northwest of Bishop.

MARIPOSA COUNTY

Tyro—The mine, near Coulterville, owned by McClure Gregory, is being put in operation and is to be unwatered and retimbered. This is an old mine, equipped with a 10-stamp mill.

Hite—The owners of this mine are building a road from the railway station so as to haul in machinery.

MONO COUNTY

Golden Star—Meagher & McDonnell have made a strike of good ore in the tunnel of this mine at Bodie.

NEVADA COUNTY

Moore's Flat—In this section of the county there is considerable activity at present. C. L. Wilson, of Lincoln, has bonded a number of claims and is doing development work upon them. Four tunnels are being run and a mill will probably be erected next season.

Erie Consolidated Mines Company—The old Erie mined in the Graniteville district will be actively worked by this new company. There is on the property a 30-stamp mill, air compressor, drills, etc., and water power is available. R. G. Eckis, of Oakland, is manager.

El Oro—The 10-stamp mill and other buildings of this mine at Washington have been destroyed by fire.

SIERRA COUNTY

Hunch—At the claim, near Alleghany, owned by H. P. Haley, of that place, and S. B. Gracier, of San Francisco, the wide ledge recently uncovered is to be at once developed.

Foster & Squires—These men have bonded their four claims at Whisky Diggings to W. T. Forstman, of Sacramento, and work is to be commenced in 30 days.

SISKIYOU COUNTY

Atterbury—J. M. Morrison & Co., of Quartz Valley, are keeping the new mill busy on ore from this mine.

Big Cliff—At the mine on Russian creek, specimen ore has recently been struck.

California Consolidated—It is understood that this company at Rollin has reincorporated and that operations will soon commence on the Ball mine.

Oom Paul—At the mine at Oro Fino, owned by J. Carter, rich ore is being mined.

TUOLUMNE COUNTY

Eureka—As soon as electric power is provided the mill of this mine is to start a run on high-grade ore.

Gold Bar—At this claim in Knight's creek district, 15 miles north of Sonora, a 7-ft. vein has been found by Faller & Oakes.

O'Hara—On Brown's flat, a mile from Sonora, this mine has been bonded by T. C. Crawford and London associates. Two years ago a rich strike was made in the property and an effort to reopen the oreshoot will now be made. John F. O'Hara will be in charge.

Dutch—Charles H. Segerstrom, of Sonora, has an option of this property, which is being reopened after an idleness of three years. The shaft is 1750 ft. deep and there is a 20-stamp mill on the property.

Colorado

GILPIN COUNTY

Cyanide Mill—Henry P. Lowe, of the Topeka and Frontenac groups, is arranging to establish a 10-ton experimental cyanide plant at the Frontenac mill on North Clear creek, east of Blackhawk. Tests are to be made of various ores in the district as well as those of the above mines.

Druid—In Willis gulch, a new shaft house is to be erected at the Searle shaft and additional equipment is to be installed under the direction of Max Boehmer, consulting engineer, formerly of Leadville.

FREMONT COUNTY

Rocky Mountain Smeltery—This plant, situated one mile south of Florence, is to be sold at sheriff's sale on Sept. 24 to satisfy a judgment of $78,130, held by the Iowa Fiduciary Company against the Colorado Smelting and Refining Company, which acquired the property about two years ago.

LAKE COUNTY—LEADVILLE

Evelyn—From the Boulder shaft, in South Evans gulch, a drift has been driven east 500 ft. toward the Ball mountain fault. The last 150 ft. has been through porphyry and several small veins were encountered; a 50-ft. raise made on one of the streaks has opened a 5-ft. orebody. The drift will be continued until the fault is reached.

Iron Hat—Lessees at this shaft of the Iron Silver company in Graham park have encountered a good streak of ore, carrying silver and a fair percentage of lead. Operations are confined to a drift started at a depth of 100 feet.

Silent Friend—A vein of excellent ore has been encountered recently in the mine in South Evans gulch. Lessees are taking out the ore through the Yak tunnel.

Garibaldi—Steady operations continue on the tunnel at the head of California gulch. The vein discovered there some months ago has been developed to a considerable extent and continues to maintain its value and size.

Little Evelyn—Work on the St. Louis tunnel is progressing favorably. A good breast of gold-bearing ore has been uncovered in the old workings and as soon as the necessary repairs have been completed, the work of taking out ore will be commenced.

TELLER COUNTY

Gold Dollar Consolidated—Of eight sets of lessees operating on the property of this company, six are mining ore. The most important lease is held by the Union Leasing Company, operating the Mable M. and Husted shafts. During the last three months nearly $10,000 has been paid in royalties.

Henry Adney—Operations have been resumed at this Beacon hill property. The 400-ft. level is the present water level of the mine, which will be one of the first to be relieved by the deep drainage tunnel.

Rexall—In the Spicer mine, the company has opened a new vein about 150 ft. north of the inclined shaft at a depth of about 700 ft. From 12 to 18 in. of the 5-ft. lode is of smelting grade. H. R. Brooks, Victor, Colo., superintendent.

Idaho

SHOSHONE COUNTY

Gold Hunter—The new hoisting equipment having been installed, sinking is to be resumed at the property east of Mullan.

Great Northern—Ore has been struck on this property comprising six claims situated between the Great Eastern and the Hecla, about 1½ miles from Burke.

Iron Mountain—About 60 men are employed and a new hoist and compressor have been installed. The three-compartment shaft will be sunk another 150 feet.

Montana Standard—At the annual stockholders' meeting held at Wallace, Aug. 16, the following directors were elected: O. A. Schenck, B. B. Baker and John Chester of Columbus, O.; H. Eddy of Chicago; J. D. Murphy of Spokane; M. J. Maher of Burke; and Scott Webb. A test shipment has been made to the American Concentrating Company, of Joplin, Mo., to determine the equipment to be used in the proposed concentrating mill.

Knickerbocker—W. B. Pickrell and W. B. Forrester, of Osborne, have bonded this group of seven claims in the Osborne section.

NEZ PERCE COUNTY

Black Lead—Development work is to be undertaken at once at this property recently sold to F. W. Bradley and associates.

Illinois

Dering Coal Company—The American Trust and Savings Company, of Chicago, trustees, has begun suit to foreclose the general mortgage on this company's mines, executed in 1905. The mortgage covers mines in Sullivan, Vermilion and Vigo counties in Indiana and in Franklin and Vermilion counties in Illinois.

Indiana

VIGO COUNTY

Deputy State Mine Inspector Thomas has had suit filed against the following companies for alleged violation of the mining laws in regard to the proper conditions in the mines: The Deep Vein Coal Company; the Atherton Split Coal Company and the Grant Coal Company.

Officials of the Indiana district of the United Mine Workers have served an ultimatum on the Pittsburg Mining Company, that grievances arising from cutting break-throughs, turning rooms and removing slate must be redressed at once or the 225 workmen will be ordered on strike. The situation is exceptional because the company is not a member of the Indiana Operators' Association, and therefore, not amenable to the rules in the wage contract providing for the handling of grievances.

CLAY COUNTY

The suit of Benjamin Simpson against the Big Four Railroad Company to recover $150,000 will be tried this term. Simpson alleges that the defendant company made a deep cut in its road through his coal land and flooded his coal mines with water so that he was compelled to stop mining. Much interest is manifested in the case by mine owners and railroad officials.

Kansas

CHEROKEE COUNTY

Heap-O'Brien—The company has placed a contract for a mill on its land south of Baxter Springs. Manager R. R. Heap, of Baxter Springs, expects the plant to be in operation by Nov. 1. Good bodies of

zinc and lead ore have been opened from two shafts.

Ohio—Favorable prices of zinc ore have had a stimulating effect on prospect work on this tract, which is situated in the heart of Galena. New producers are being opened up and worked at a profit.

Sawyer & Co.—C. L. Sawyer and associate, J. M. Pollard, are opening a rich run of silicate ore in the east part of Galena. The discovery is of much value as it opens up land hitherto regarded as valueless. Ore was found at a depth of 70 feet.

Hickory Flat—Near Short creek on this land, J. L. and Henry Phillips, Charles Trombold and C. W. Adams, of Galena, are working a 15-ft. face of zinc and lead ores in a new shaft 85 ft. deep.

Stone, Cook & Co.—Pumps have been started by this Galena company on the Black Hills lease in the southwest part of Galena. The land has been flooded several years and formerly was a good producer.

Mission—Construction of the company's new 200-ton mill, south of Baxter Springs, has been commenced by the Webb City Iron Works.

Sunburst—On the company's lease, south of Baxter Springs, a big run of lead ore has been found in the "Big Four" shaft by J. W. Barnes. Drill prospecting on this land also indicated good zinc ore.

Kentucky

LAUREL COUNTY

Bell-Jellico—R. M. Jackson, London, Ky., has been appointed receiver for this coal company, which has offices at Lexington, and at Pittsburg, Penn. Allegations of fraud were made by President Charles F. Coffin, of Indianapolis.

BELL COUNTY

Coleman Mining Company—A new electric haulage equipment has been put in the mine at Cary, and will soon be in operation. It has a capacity of 600 tons per day.

Michigan

COPPER

Michigan—The company has started the fourth drill hole of the series that is being put down along the strike of the three lodes disclosed on the Adventure lands, the third drill core having shown encouraging results. A crosscut has been extended from the eighth level of C shaft to the Minnesota conglomerate lode and drifting from that point has been started. The old shaft on the Bee tract, which was put down on this lode to a depth of about 220 ft. is being unwatered and a crosscut will be driven from the bottom to tap the amygdaloid lode opened in the adit level of this tract. Drifting on this lode continues and some unusually rich streaks are opened from time to time.

Mass—The company continues opening on the New Mass lode and will soon have it sufficiently opened to keep one head in operation and determine the commercial value of the formation.

Keweenaw—This company is diamond drilling with the view of opening the Osceola amygdaloid and the Calumet conglomerate lodes on its lands. The site for two shafts on the Kearsarge lode has been established and will soon be under way. At one point it is planned to drift on the formation at a depth of about 50 ft. Operations are being carried on at the Medora shaft on a small scale, two drills being operated on the west fissure vein at the 13th level.

IRON—GOGEBIC RANGE

Bonnie—The working force has been increased at this mine, near Ironwood. It is a Schlesinger property and adjoins the Newport.

IRON—MARQUETTE RANGE

Conrad—This old mine, with the adjoining Hurkins tract, has been taken under option by George J. Maas, of Negaunee, and will be thoroughly tested.

Montana

BUTTE DISTRICT

Tuolumne—The company has recently commenced the shipment of ore to the Butte Reduction Works at the rate of 100 tons per day.

Butte Coalition—Sinking is in progress at both the Rarus and Tramway shafts. An 18-ft. fan is being installed at the air-shaft of the Rarus, by means of which it will be made an upcast. The company has built several hundred additional lockers for the use of miners at the Minnie Healey, which is taken as an indication that it is preparing for a much larger production.

Davis-Daly—The breaking of a rod on the main hoist at the Colorado shaft caused the cage to drop from the surface to the sump, a distance of 1600 ft., where it was stopped by a bulkhead built for the protection of the men at work sinking. The solid construction of the bulkhead was all that saved the lives of the three men working beneath it. The drum of the engine burst during the runaway and fragments were hurled through the roof, a distance of 200 yards. It is expected that the hoist can be repaired within a few days, when operations will be resumed.

Butte Production—The output of this camp for the month of August is estimated at 26,148,440 lb. of copper, a slight decrease compared with previous months, due principally to the fact of the Mountain View mine of the Boston & Montana not hoisting for over two weeks, owing to a broken driving shaft. The ore produced by the various properties was as follows: Boston & Montana, 87,200 tons; Anaconda, 93,000; North Butte, 39,600; Butte & Boston, 14,260; Washoe, 12,300; Butte Coalition, 46,200; Parrot, 7400; Trenton, 12,900; W. A. Clark, 27,320; East Butte, 12,000; miscellaneous, 3200; total, 355,380 tons.

GALLATIN COUNTY

Montana Portland Cement Company—Under the direction of O. B. Gilson, the work on the new cement factory at Trident is being pushed, and is to be completed by Nov. 1. Two steel kilns, 150x9 ft. in diameter, two rock crushers, and a steam shovel are now being installed.

JEFFERSON COUNTY

Montana-Corbin Company—Two large boilers and a 10x12 hoist have recently been installed at the property and an electrically driven compressor will be added when the power line of the Missouri River Power Company reaches the mine.

Boston & Alta—The surface plant at present consists of two 75-horsepower boilers, one 4-drill Rand compressor, a gallows frame and a Lidgerwood hoist, good for 500 ft. A 30x70 building is being fitted up as a boarding house for the men.

Calumet & Corbin—The sinking of a 200-ft. shaft has been started. When that depth has been attained crosscuts will be run.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Frances-Mohawk Mining and Leasing—On Aug. 31, the Western Trust and Savings Bank of Chicago, was appointed receiver for the company on complaint of dissatisfied Chicago stockholders, who also secured an injunction restraining the officers of the company from removing $125,000, on deposit in that city.

Goldfield Belmont—A recent shipment from the Burke lease, comprising 64 tons from the oreshoot just discovered, yielded over $11,000 in net returns.

Goldfield Mining and Ore Reduction Company—Two shifts are employed upon this property sinking the shaft to the 300-ft. point. Marvin Arnold is manager.

Goldfield Daisy Mining Syndicate—General Manager Charles D. Wilkinson has announced that portions of the company's acreage, heretofore denied to leasers, are now to be leased.

Atlanta Mines—On the Precious Metals lease a new 45-h.p. hoist has been installed and two shifts are being employed in sinking the shaft 200 ft. deeper.

Nancy Donaldson—A vein, having a width of about 1 ft., has been cut at a depth of 85 ft. in this shaft.

ESMERALDA COUNTY—SWEETWATER

United Gold—This corporation has purchased rights and title of the Sunny Jim Gold Mining and Milling Company and the Tyler Gold Mining Company. There

are 15 claims in the group, which is situated four miles north of the Pittsburg-Liberty property. Plans are being prepared for the first unit of a mill.

ESMERALDA COUNTY—RAWHIDE

Kerns No. 1—Sub-leasers on the upper lease are now working 25 men and much ore is being taken out and hauled to the mills; the lease expires on Sept. 15.

Kerns No. 2—Bins to accomodate the large amount of ore being extracted have been erected. The new leasers now have ore, mostly of a milling grade from the 80 to the 400-ft. levels. It is understood that the new leasers are paying 30 per cent. royalty to the owners of the Rawhide Queen Mining Company.

Salt Lake-Rawhide—This company, J. C. Guerin, president, J. A. Salsbury, general manager, is soon to install a hoisting plant on its property. At present the shaft is down 75 feet.

LINCOLN COUNTY—FAY

Horseshoe—The 100-ton mill and mine, owned by the Stokes of Los Angeles,, has recently been bonded to E. E. Fuller, and the mill put in shape to retreat some of the old tailings.

Tyson—W. S. Anderson, of Pioche, has begun active development of property at this new camp, three miles from Fay.

LYON COUNTY

Nevada Copper Belt Railroad—Contracts have been let for the construction of the first portion of this road, which is to tap the Yerington copper district from the Southern Pacific station at Wabuska. The new road is controlled by interests affiliated with the Nevada-Douglas Copper Company.

Mason Valley Copper—Development work from the No. 4, or lower tunnel, during the last two months, has added approximately 100,000 tons to the reserves. The northern section of the property is now being given more attention and a drift that is being driven toward the Bluestone has a full face of good ore.

NYE COUNTY—BULLFROG

Fleming—A strike is reported on this lease on the National Bank property.

NYE COUNTY—PIONEER

Pioneer Leasing and Milling—This company has been granted a year's extension on its present lease, including the Bimetallic No. 3 claim and a portion of the Conservative claim. Preparations will at once be made for extensive new development.

NYE COUNTY—RHYOLITE

Montgomery-Shoshone—The net profits of the company for the first six months of 1909 were $126,500, being about 50 per cent. of the gross receipts. The mill is treating about 6000 tons per month, the ore coming from between the 200- and 500-ft. levels. The glory hole is now 250 ft. long and 175 ft. wide, with ore exposed on three sides. Development has started on the 700-ft. level as the beginning of an extensive campaign of new work.

WHITE PINE COUNTY—ELY

Steptoe—The August crushing of this plant was 180,000 tons. Some days in excess of 7000 tons were handled. The copper production for the month was in excess of 5,000,000 pounds.

Ely Central—Funds have been provided for sinking the three-compartment shaft on the Eureka Fraction and two more drills have been ordered for the prospecting of the Chispy and Quartette claims, which are about 600 ft. from the Nevada Consolidated line.

WHITE PINE COUNTY—SHOSHONE

St. Lawrence—Engineer C. E. Allen and J. Fewson Smith, of the United States Smelting, Refining and Mining Company, have made an examination of this lead property, 12 miles south of Osceola.

New Jersey

SUSSEX COUNTY

New Jersey Zinc Company—Preparations are being made to sink a new shaft at Franklin Furnace, some distance from the old shaft. When it is completed the old shaft will be repaired and relined New machinery is also to be installed for the purpose of lighting the underground workings by electric light.

Ohio

STARK COUNTY

Massillon Coal Mining Company—The report for the fiscal year ended May 31 shows 176,021 tons coal sold for $372,882; other income was $7295, making a total of $380,177. Costs of mining and selling were $328,989; development, $24,000; a total of $352,989, leaving a net income of $27,188. The interest on bonds was $15,000 and $100,000 was charged as depreciation, showing a loss of $87,812 for the year.

Oregon

JOSEPHINE COUNTY

Chatty-Maurer—At this property, situated in the Cañon Creek district, 7 miles west of Kirby and 37 miles from Grant's Pass, a good showing of free-milling gold ore is reported.

United Copper Gold Mines—Owen Thomas, manager, has a crew of 30 men driving tunnels and installing equipment. A wagon road from Booth's Ferry on the Rogue river to the mine at Pickett Creek has lately been completed.

Pennsylvania

ANTHRACITE COAL

Hillside Coal and Iron Company—A fire at the Dupont colliery last week destroyed the boiler house, fan house and some other buildings, and damaged the shaft badly.

Lehigh Valley Coal Company—Hazelton shaft breaker is being rebuilt and enlarged, and will handle the coal not only from its own colliery, but also from the Gowen and Tomhicken collieries, two of the old Coxe Brothers' mines. The old Tomhicken breaker will be torn down.

Lehigh & Wilkes-Barre—A rescue station has been established by the company at the South Wilkes-Barre colliery, and a brick building has been built to accommodate the equipment, which will comprise six Draeger helmets, equipped with oxygen apparatus, portable electric lamps, and oxygen cylinders with suitable attachment for supplying oxygen at the earliest moment to rescued men. The rescue department will be in charge of Tudor Roberts, and the apparatus will be taken to the various mines in the district, so that certain men at each colliery will be familiar with the rescue work and apparatus. It is planned by Chief Engineer Douglas Bunting to have auxiliary stations at the various mines in this section, but all will be under the direction of the main station.

Yost Coal Company—This company, just organized by Edward Shaughnessy and others, of Pittston, has leased a tract in Yatesville. Contracts have been let for sinking a slope and building a breaker. The company will be able to ship over the Delaware & Hudson, or the Erie.

Philadelphia & Reading Coal and Iron Company—Tne statement for July, the first month of the fiscal year, is as follows:

	1908.	1909.	Changes.
Earnings.....	$1,954,763	$1,597,096	D. $357,667
Expenses	1,894,941	1,691,335	D. 203,606
Net or def..	Net $59,822	Def. $94,239	D. $154,061

The expenses were 96.9 per cent. of earnings in 1908, and 105.9 per cent. this year.

BITUMINOUS COAL

Globe Coal and Coke Company—This company, of Pittsburg, has leased a tract of coal land at Fort Hill, near Confluence, on the Baltimore & Ohio, and has let contracts for a new tipple and other improvements.

Penn-Mary Coal Company—An issue of $2,000,000 in 5 per cent. bonds has been made for the purpose of developing coal lands in Indiana and Cambria counties. The bonds are guaranteed by the Pennsylvania Steel Company.

Tennessee

CAMPBELL COUNTY

Southern Coal and Coke Company—A contract has been taken to furnish coal for a year to the Seaboard Air Line railway. The company has its office at Knoxville, Tenn., and operates mines in the Jellico district.

POLK COUNTY

Tennessee Copper—It is reported that the company has placed its $600,000 issue

of 6 per cent. three-year notes, the proceeds of which are to be applied to the construction of the new $800,000 unit of the sulphuric acid plant. The unit now in operation has an annual capacity of 300,000 tons of acid. The company's copper output is being maintained at about 1,250,000 lb. per month at a cost of slightly over 10c. per lb., without crediting revenue from the sale of sulphuric acid. The company has ore reserves and smelting facilities for an annual production of 18,000,000 lb. of copper, whenever the price of the metal becomes an incentive to reach this output.

Utah

BEAVER COUNTY

Wild Bill—Matthew Cullen, of Salt Lake, will soon open this property which he has owned since the early 60's. Formerly the surface ores of this mine produced a fortune, and Mr. Cullen now intends to install a hoist and compressor plant to go after the large bodies of ore which are believed to lie at depth.

Cedar-Talisman—An important orebody carrying silver, lead, copper and gold, has been opened on the 400-ft. level. S. S. Pond, manager, Beaver, Utah.

JUAB COUNTY

Tintic Smeltery—Four furnaces are again in operation at this plant, and power is being supplied by the new electric plant.

Ore Shipments—The Tintic ore shipments for the week, ended Aug. 27, were: Centennial Eureka, 40; Gemini, 2; Scranton, 4; Mammoth, 2; Grand Central, 2; Victoria, 2; Sioux Consolidated, 14; Colorado, 41; May Day, 3; Eagle & Blue Bell, 1; Chief Consolidated, 1; Uncle Sam, 4; East Tintic Development, 2; Iron Blossom, 41; Dragon Iron, 34; Beck Tunnel, 4; Ajax, 3 cars.

SALT LAKE COUNTY

Columbus Consolidated—A new and independent body of ore has been found in the Columbus Consolidated property at Alta in the 100-ft. level, west of the shaft. Manager Tony Jacobson also reports that the management is extracting ore for shipment from the 400 level.

Prince of Wales—The leasers of the old mine at Alta have encountered a vein which exhibits many of the characteristics of the old bonanza shoot. Fred Schrott, manager, Alta, Utah.

North Bingham—An important strike has been made in the property at Bingham. A tunnel is now being driven, and as the cañon is precipitous, considerable depth has been reached. Jesse Knight is interested.

SUMMIT COUNTY

Iowa Copper—A body of copper ore has been opened in a winze 50 ft. from the tunnel level. Shipments have commenced. A. M. Spooner, manager, Park City, Utah.

TOOELE COUNTY

Boston-Sunshine—Ore has been extracted from all the levels in the mine from the first to the sixth. A good body of ore has been developed on the 300-ft. level, which has given the best results of any ore that has been run through the new mill. On the 600 level ore has also been developed, and the management will install a hoist to expedite further work at depth. George H. Dern, manager, Salt Lake.

Washington

CHELAN COUNTY

Washington-Meteor—Davis & McDowell, who recently acquired the Blinn group, have also leased this property.

Chelan Consolidated Copper—The company has driven an adit into Red mountain 1300 ft. and opened a 5-ft. vein of high-grade ore at a vertical depth of 1500 feet.

Chihuahua Lead and Silver—The company is driving a long adit in the Red mountain district to cut the vein exposed at the surface of the property.

Wisconsin

IRON—GOGEBIC RANGE

Geneva—The shaft is now down 2200 ft., and will be sunk some distance further before stoping is begun.

Norrie—A new three-compartment shaft is to be sunk east of B shaft.

Puritan—The main shaft is now down 1300 ft. Some ore has been taken out, but it has been stocked, and no shipments will be made till the shaft is completed.

Canada

BRITISH COLUMBIA—CARIBOO

An important find of gold-bearing quartz is reported from the Barkerville district. The lode occurs on the divide between Grouse and Antler creeks. For a width of 8 ft. the lode has a high gold content, and there is a greater width of lower-grade quartz.

BRITISH COLUMBIA—EAST KOOTENAY

Sullivan—Pumping is in progress at this group, which had been closed since February, 1908. Mining will be resumed early in September, and smelting at the lead smeltery at Marysville, as soon thereafter as sufficient ore has accumulated.

BRITISH COLUMBIA—HEDLEY

Nickel Plate—This mine and 40-stamp mill, formerly owned by Marcus Daly, has been purchased by the Exploration syndicate. Frank Atherton Ross, of Grand Forks, B. C., formerly managing director, will remain in charge.

BRITISH COLUMBIA—NELSON

Silver King—Fire has destroyed the compressor house, blacksmith shop, ore bins and upper terminal of the aërial tramway at the mine, on Toad mountain, a few miles from Nelson. The destroyed property will be replaced as quickly as possible. R. S. Lennie, manager.

BRITISH COLUMBIA—SLOCAN

Lucky Jim Mines, Ltd.—Thirty cars of zinc ore shipped during recent months from the Lucky Jim mine to the Empire Zinc Company, of Denver, Colo., averaged in value $30.55 per ton. The freight charges were $8.86 per ton.

ONTARIO—COBALT

Ore Shipments—Shipments of ore from Cobalt for the week ended Aug. 28, were as follows: Carnegie, 63,410 lb.; Crown Reserve, 124,000; La Rose, 193,020; McKinley-Darragh, 40,980; Nipissing, 255,170; O'Brien, 129,640; Right of Way, 60,210; Trethewey, 66,000; total, 932,430 pounds.

Nancy Helen—A 5-in. vein, carrying high-grade ore, was uncovered in drifting at the 60-ft. level.

Rochester—The directors have decided to increase the capital stock from $1,000,000 to $1,500,000, and to issue the new shares at 10c. or upward, the funds to be used for further development. A meeting of shareholders has been called for Sept. 10 to ratify their action.

Martell—A 12-in. calcite and silver vein has been uncovered on this property which lies directly south of the Waldman location in the Gillies limit.

ONTARIO—GOWGANDA

Boyd-Gordon—Drifting east and west at a depth of 87 ft., eleven veins have been encountered. Two of them which promised well on the surface show increased silver content at depth. A carload of ore is sacked ready for transportation.

Bartlett—The shaft is down 110 ft., and a station is being cut at that level. Seventy men are at work with four drills running. An electric-light plant is being installed. A number of surface veins have been uncovered by trenching.

ONTARIO—PORT ARTHUR

Dominion Bessemer Mines Company—The company is commencing operations on an extensive scale at its iron properties at the head of Thunder bay, 22 miles from Port Arthur. Docks are being built so that shipments may be made direct by water next season. The company owns 6000 acres of iron lands.

QUEBEC—BLACK LAKE

Amalgamated Asbestos Company—E. B. Greenshields, Thomas McDougall, H. E. Mitchell and H. H. Melville, directors, visited the properties recently and were much pleased with the discovery of a new vein of No. 1 grade, made in one of the British-Canadian pits. It is announced that a large amount will be expended on improvements on the Standard and Dominion properties in order to double the output and keep pace with orders. An order has been received from Germany for 20,000 tons.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, Sept. 8—Western coal trade continues to increase in activity and bulk, but as yet there appears to be no general upward movement in prices. Competition seems to be the chief factor in keeping prices stationary.

Uneasiness is growing in certain sections of both the East and West regarding car supply. Reports from Indianapolis indicate that car shortage threatens seriously to curtail the Fall production in that district. New York reports car shortage on the Baltimore & Ohio, Norfolk & Western and Chesapeake & Ohio railroads. Car transportation is slow, coal taking a little more than schedule time to run through on most roads.

The anthracite market shows a decided improvement, with prices unchanged.

Coal Traffic Notes

Coal tonnage originating on the Southern Railway in June was 279,208 short tons; for the six months ended June 30 it was 1,750,663 tons.

Shipments of Broad Top coal over the Huntington & Broad Top railroad for the seven months ended July 31 were 376,710 tons in 1908, and 262,173 in 1909; a decrease of 114,537 tons.

New York

Anthracite

Sept. 8—There is a decided improvement in the demand for anthracite coal. Prices are the same at $4.75 for lump and $5 for egg, stove and chestnut, f.o.b., New York harbor. For steam sizes prices are unchanged, quotations being: Pea, $3.15@3.25; buckwheat, $2.35@2.50; No. 2 buckwheat or rice, $1.70@2; barley, $1.35@1.50; all f.o.b. New York harbor.

Bituminous

There is a gradual increase in tonnages and the trade expects this to continue. This condition has been coming in flushes for the last few months, and lately signs of better shipments have been gradually becoming more common. As yet this has not affected prices, although they appear somewhat stronger.

The question of car shortage is coming into play and at times coal producers are not able to fill orders in hand as heretofore. With reported small supplies of soft coal on hand in the bins of consumers and winter months approaching, the immediate prospects appear somewhat brighter—this in particular as regards tonnages and probably as to prices.

The Far East is taking moderate amounts of coal upon contracts, although it continues to be chary as to getting much stock on hand. Favorable ocean freight rates are an inducement in this particular. Several brokers, however, do not think the extra low rates now prevailing will continue much longer. Trade along the Sound shows a better condition, and coal is being taken on in larger quantities. In this consuming territory prices continue unchanged.

Trade in New York harbor is quiet and outside of the usual contractors not much new business is being transacted. A few works which have been closed down are starting up, however, and these are taking coal which amounts to considerable in the aggregate.

Prices on current business for gas coal (run-of-mine coal) are 65c. per ton at mines. Ordinary steam coal can be bought at a round figure of $1 per ton at the mines; good South Fork, Miller vein, coal can be bought at prices based on $1.30 at mines.

In the coastwise market vessels are seeking charters, with a plentiful supply on hand. Rates are quoted from New York harbor on medium-sized vessels at 50 to 55c. per ton around Cape Cod. The Philadelphia quotation on large-sized vessels is 50 to 55c. around the cape.

Birmingham

Sept. 7—Conditions continue to improve slowly. The railroads are the chief consumers of coal, and the brighter outlook in traffic business holds forth brighter prospects for the coal mines. While there is as yet no boom in the coal business, present conditions and the outlook for the future are entirely satisfactory.

Chicago

Sept. 6—Sales of nearly every kind of coal are good, with the market firm and growing stronger as the season of activity approaches. Increasing steam consumption keeps up the prices of fine coals as well as lump, and domestic supplies are being laid in somewhat generally. Shipments are well regulated to the demand, with the result that except on run-of-mine smokeless there is practically no coal sold at sacrifice prices to avoid demurrage charges. Prices have not risen and are not likely to rise generally, in view of the keen competition that exists on all classes of bituminous. A slight advance, however, may occur in Illinois and Indiana lump sizes, and Hocking (1¼-in.) has advanced to $1.40 at the mines or $3.05 Chicago, with good sales at the increased price. Country dealers are buying domestic coals more freely, very generally.

Illinois and Indiana lump bring in car lots, $1.75@2.25; run-of-mine sells for $1.60@1.75 and screenings hold up fairly well at $1.25@1.45. Smokeless, the chief of eastern coals, finds an increasing demand, with $3.45 on lump and $2.95 on run-of-mine (freight being $2.05), standard prices that are well adhered to in general for Pocahontas and New River. Anthracite sales are light but well distributed.

Indianapolis

Sept. 6—With the hight of the coal season but a few weeks off and the different railroads hampered by a car shortage, many complaints from the operators of the mines in the Indiana district have reached the railroad officials. The operators say no definite answers can be obtained why the cars are so scarce. Operators in the Terre Haute district say the situation has become so severe that only two or three hours a day can be worked at some mines because there are no cars to fill the orders. Operators say that unless something is done to relieve the situation their fall output will be greatly diminished.

At Fontanet much trouble is being experienced, and it is claimed that on an average of three hours a day can hardly be maintained at a number of mines on the Big Four right-of-way. It is reported that the Vandalia road has been furnishing enough cars to allow the mines reached by it to run half-day shifts, but this is far from being enough to supply the demands of the miners.

Pittsburg

Sept. 7—The coal market has gained slightly in activity, with increasing consumption in the manufacturing industries. Nominal prices remain at $1.10 to large manufacturers and $1.20 to retail dealers, for mine run, and 65c. for slack. These prices are not subject to as much shading as a month or two ago, and it is only on

strongly competitive business that mine-run sells down to $1, or slack to 50c. It is possible that later in the year an advance in schedule prices will be made, but none is in contemplation for the present.

Connellsville Coke—The market continues to advance. In the past week sales of furnace coke have been made of 2000 tons for September delivery at $2 at ovens and 5000 tons for September and early October at $2.10, and the market is very firm at this range, there being no coke to be picked up, even for spot shipment, at less than $2. Comparatively little furnace coke is being sold for the remainder of the year, consumers being already covered, but a few such have been put through in the past week, one of 6000 tons monthly being made at $2.25. There is more inquiry for coke for next year, both for six months and for the whole year, but flat prices are generally quoted at not less than $2.50 and furnaces are not disposed to pay this price. Occasionally contracts are being made on an exchange basis of coke for pig iron, while sliding-scale contracts, referred to the average selling price of pig iron, are growing in favor. The sharp advance in coke in the past two or three weeks is attributed to the scarcity of labor, as there is plenty of idle capacity to bring in if men could be found. This position should right itself very soon and furnaces then expect coke prices to be a little easier. We quote standard Connellsville coke as follows: Prompt furnace, $2@2.10; fourth-quarter contract, $2.25; first-half contract, $2.50; 72-hour foundry, prompt or fourth-quarter, $2.25; first-half, $2.50.

The *Courier* reports the production in the Connellsville and lower Connellsville regions in the week ending Aug. 28 at 416,354 tons, a gain of almost 20,000 tons from the previous week; and shipments at 4980 cars to Pittsburg, 7426 cars to points west of Pittsburg and 806 cars to points east of Connellsville, a total of 13,212 cars, or about 100 cars more than in the previous week.

St. Louis

Sept. 6—With the advent of September a decided improvement in demand was noted by all wholesalers. Prices have stiffened a little, though the improvement has shown itself more in the line of increased tonnage than in any general advance in prices. Quite a few operators reported today that for the first time in the last eight months they had their entire outputs sold up for some time ahead.

The operators in the Staunton field have raised their price from $1 to $1.10 on 3-in. lump coal. These operators have been making 6-in. lump and 3- to 6-in. egg all summer, but now on account of the increased tonnage have found such difficulty in disposing of the 6-in. egg that nearly all of them have discontinued making it and are making only 3-in. lump.

The price on standard coal has stiffened and 3-in. lump is now bringing 80c. at the mines, or $1.32 St. Louis, with mine-run bringing 70c. at the mines, or $1.22 St. Louis. Prices on the whole are about 5c. per ton higher than prevailed last week.

The operators of high-grade mines in southern Illinois are running full time, and orders are coming in so freely that higher prices will prevail before long. Carterville 6-in. lump or egg is strong at $1.20 f.o.b. mines, or $1.87 St. Louis, while Franklin county is bringing $1.40 f.o.b. mines, or $2.07 per ton St. Louis. The price on the celebrated Trenton high-grade coal was advanced from $1.75 to $2 per ton f.o.b. mine for 6-in. lump on the first of the month, which makes this coal now cost $2.52 per ton f.o.b. St. Louis. This is about 50c. per ton higher than any other high-grade coal is bringing.

The anthracite situation is gradually clearing up. The cheap hard coal which has been a troublesome factor is slowly disappearing. Indications are that hereafter the circular price of $6.95 per ton f.o.b. St. Louis on the chestnut, stove and egg sizes, and $6.70 on the grate will be strictly adhered to.

The report comes from Terre Haute, Ind., that the United States Steel Corporation on Sept. 1 acquired the coal property from the Hammond company, on which it has had an option for some time. These properties were sold several years ago for $3,000,000.

Foreign Coal Trade

Welsh Coal Prices—Messrs. Hull, Blyth & Co., London and Cardiff, report current prices of coal as follows, on Aug. 28: Best Welsh steam, $4.38; seconds, $4.08; thirds, $3.90; dry coals, $4.08; best Monmouthshire, $3.60; seconds, $3.48; best small steam, $2.28; seconds, $1.92. All per long ton, f.o.b. shipping port.

Iron Trade Review

New York, Sept. 8—There was a decided improvement in the iron and steel markets last week. In finished products, although Pittsburg reports firmness in orders and prices, Chicago reports heavy sales in all departments.

Large sales of pig iron were made at Chicago, the market being strong with promise of greater activity. The Pittsburg furnaces have advanced the price on all grades of pig, but the market is not active. Prices for basic at Philadelphia have been advanced on account of the sold-out condition of the market. Birmingham producers are holding No. 2 foundry at $14; demand is strong. There is an improvement in general conditions in all districts.

Chicago

Sept. 6—Sales of pig iron have been large in the last week and the market is strong, with promises of increasing strength in every line. In addition to a number of large contracts, the demand for more pig iron has become notable from almost every melter. The timidity that has existed for several months has disappeared. Many melters are now willing to buy freely for 1910 delivery and others have large inquiries out and are closely watching the market.

For first-half deliveries $14.50 Birmingham ($18.85 Chicago) for Southern and $18.50 for Northern may be considered standard, with a range of 50c. up or down on the more or less desirable contracts. Northern iron is especially in demand, with prices very firm. On last-quarter business prices are about 50c. less than on 1910 business. The increased demand is for all kinds of iron, showing a general determination of the market to buy on the upward wave of increasing consumption and recovered confidence.

For iron and steel products the market shows large sales in practically all lines, with structural steel and railroad supplies notably in demand. Coke continues at $4.85 for the best Connellsville with sales large and increasing.

Philadelphia

Sept. 8—The output of basic has been sold about as far ahead as producers care to sell and buyers who have not covered as fully as they desire are seeking outside sources. Prices in consequence have been marked up. The effect of this is to make certain consumers more anxious and inquiries have been presented this week asking as to deliveries during first quarter 1910. It is said arrangements have been made by a few buyers for the second quarter. Pipe iron has just been advanced. Pipe manufacturers were shortsighted when they booked a large amount of business early in the summer, by not contracting for all the pig their contracts called for. Implement and accessory manufacturers are in the market for special irons, including malleable. Foundry No. 2 is quoted 50c. higher for early deliveries but buyers say this asking price can be shaded. Forge is quiet after the placing of orders by several mills to cover work that is assured. The tone of the market is strong and furnace men think there will be no further climbing of prices for awhile.

Steel Billets—Buying is mostly restricted to small lots. The larger interests have covered probable demands by contracts extending over a considerable period. The probability is, though not admitted, that the price to be paid for future deliveries is to be fixed when deliveries are called for.

Bar Iron—Offers have been received

this week from large consuming interests for winter deliveries of common iron. Price offered not given. Refined orders pour in, but for small lots, and all quick deliveries are taken at full quoted prices.

Sheet Iron—The inflow of business continues and manufacturers report a return to about normal conditions. Most sheet buyers are ordering beyond visible necessities. Car material is quite active and there is a still further increase in corrugated orders. The mills have put on some idle capacity and full time is regarded as assured.

Pipes and Tubes—Merchant pipe is quiet and no further advance has been made. Tubes are very strong and mills are reported to have booked a large amount of business. The Baldwin Locomotive Works have 7000 men at work, maximum capacity. Boiler shops are now on full time with few exceptions. Ship yards are preparing estimates upon some very important work.

Plates—Deliveries on contract time are being insisted upon by large concerns using plates. Most of the orders for car builders have been placed, some of them calling for delivery in midwinter. The plate mills are all crowded with work and with the certainty of more car-building orders, manufacturers say they have every reason to be satisfied. Building operations are greatly in excess of last year and many of these call for iron.

Structural Material—The week has not developed any important orders, though there is a steady run of business for small bridges and buildings from our immediate territory. The best encouragement for new work comes from outside territory.

Steel Rails—There has been some delay in the placing of orders that were expected early in September. Rail men say large rail orders are liable to be precipitated on the market at any time and that urgent orders from western sources must come to Pennsylvania. Small orders for mine rails were booked this week.

Scrap—No further developments. An attempted advance on heavy melting and No. 1 yard scrap is holding up business.

Pittsburg

Sept. 7—The tonnage of new orders and specifications for finished steel keeps up very well and prices trend toward greater firmness, but this has been the movement for a long time and the market is really uneventful as regards new developments.

The difference in activity between steel interests and foundry interests becomes more pronounced as the steel trade proper continues to increase its production, while the foundries are melting very little more iron than they did two months ago. The foundries are really not very busy, and while they have been fairly good buyers of pig iron it seems certain that the buying has been largely speculative, consumers covering for more iron than they would need if their present rate of consumption should not change. Pig-iron prices have been advancing rather rapidly, but the gain in strength seems to have been due largely to sentimental influences derived from the activity and enthusiasm in the steel trade. The question again comes up whether a material part of the activity in buying and specifying in finished-steel products is not due to manufacturers and jobbers increasing their stocks. If all the business represents actual consumption it is at least interesting to observe that the consumers of cast-iron products are not as active as the consumers of finished steel.

Cold-rolled shafting has been advanced three points, or about $3 a net ton, the new discounts being 57 per cent. off list in carload lots and 52 per cent. off in less than carloads, delivered in base territory.

Plates, shapes and bars are harder to get at minimum prices, 1.40c. on plates and shapes and 1.35c. on bars, many orders being placed at $1 a ton above these figures, while as most mills have their rolling schedules made up from six to ten weeks in advance, premiums are occasionally paid for prompt shipment.

Pig Iron—Furnaces have advanced prices rather sharply in the past week on all grades, and the market is quieter as to actual transactions, the respective parties sparring for position, while sales have been confined to relatively small lots. The lowest sellers on foundry iron have disappeared, being comfortably sold up. One valley furnace in particular, about to blow in within a month, was a free seller both for this year and next. No. 2 foundry iron is at an absolute minimum of $15.75, Valley, for early delivery, most sellers quoting $16 or higher, while for next year quotations are $16.25@16.50. Bessemer iron has advanced to $17, Valley, for prompt or fourth quarter, and we note a sale of 350 tons of prompt at this figure, besides several other moderate-sized lots. The advance in bessemer has had a strong sentimental effect on basic, which was selling at $15.25, Valley, three weeks ago, and furnaces are chary of selling at all. We note a sale today of 1000 tons of basic for October delivery at $15.75, Valley, to a merchant-furnace interest, and quote this as the minimum of the market for this year. A sale of 5000 tons was made early last week, for delivery through November, by a western Pennsylvania furnace to an Eastern steel works at $18, delivered, equivalent to between $15.50 and $15.75 at furnace. There is more inquiry from the East for basic, totaling between 20,000 and 25,000 tons. There is not much inquiry locally, one small steel works asking prices on 2000 to 3000 tons for first quarter. A sale of four carloads of spot malleable was made Saturday at $17 at Valley furnace, but the market on ordinary lots is about $16.25 Valley.

Ferromanganese—The market is very strong at a minimum of $42, Baltimore, or $43.95, Pittsburg, for prompt, while for forward delivery the market is $1 to $2 higher.

Steel—Both billets and sheet bars are scarce, and the market is higher, with few mills willing to sell. We quote bessemer billets at $25, mill, open-hearth billets at $25.50@26, and sheet bars at $26@27. Wire rods are nominally $31, but the only mills that quote are naming $31.50@32.

Sheets—The sheet market continues strong, with mills well sold up and prices firm at 2.20c. for black and 3.25c. for galvanized, with corrugated roofing at $1.55 per square for painted and $2.80 for galvanized.

St. Louis

Sept. 6—The demand for No. 2 pig iron is strong, the price being $14 per ton f.o.b. Birmingham, or $17.75 per ton f.o.b. St. Louis. Local producers who make basic and car-wheel pig report that their product is bringing $18.50@19 per ton f.o.b. St. Louis.

The demand for 55 per cent. iron ore is steady and strong at $3.50 per ton f.o.b. St. Louis. Nearly all companies producing pig iron have withdrawn quotation on iron for delivery after the first of the year. The Williamsville Iron Mountain Ore Company has just started operations in the new Missouri ironfield at Williamsville, Wayne county. It is producing a high-grade ore that runs 58 per cent. iron. This is the first to operate in this field, though several other companies are developing mines. This source of supply is very welcome to the blast furnaces around St. Louis.

Foreign Iron

German Iron Ore Trade—Imports and exports of iron and manganese ores in Germany, half-year ended June 30, metric tons:

Iron ores:	1908.	1909.	Changes.
Imports	3,320,683	3,766,827	I. 446,144
Exports	1,675,128	1,320,680	D. 354,448
Manganese ore:			
Imports	180,092	194,844	I. 14,752
Exports	1,006	1,132	I. 126

Imports of slag and slag products, 295,400 tons in 1908, and 234,481 in 1909; decrease, 60,919 tons. Exports, 39,007 tons in 1908, and 29,127 tons in 1909; decrease, 9880 tons.

Swedish Iron Trade—Exports of pig iron from Sweden for the three months ended March 31 were 14,400 metric tons in 1908, and 10,600 in 1909; a decrease of 3800 tons. Exports of other iron and steel were 44,000 tons in 1908, and 39,300 in 1909; a decrease of 4700 tons.

Production in Sweden for the three months was, in metric tons:

	1908.	1909.	Changes.
Pig iron	158,500	147,600	D. 10,900
Puddled blooms	41,300	33,000	D. 8,300
Bessemer steel	17,600	21,400	I. 3,800
Open-hearth steel	86,800	76,300	D. 10,500
Total steel	104,400	97,700	D. 6,700

There were in operation this year 99 blast furnaces, 218 puddling furnaces, 18 bessemer converters and 49 open-hearth furnaces.

British Iron Trade—Exports and imports of iron and steel and of machinery in Great Britain, seven months ended July 31, as valued by Board of Trade returns:

	Exports.	Imports.	Excess.
Iron and steel	£21,775,558	£ 4,571,404	Ex. £17,204,154
Machinery	16,535,871	2,773,924	Ex. 13,761,947
New ships	3,709,027	.....	Ex. 3,709,027
Total	£42,020,456	£ 7,345,328	Ex. £34,675,128
Total, 1908	46,663,058	7,410,738	Ex. 39,252,320

Total decrease in exports, £4,642,602, or 9.9 per cent.; decrease in imports, £65,410, or 0.9 per cent. The total quantities of iron and steel of all kinds were, in long tons:

	1908.	1909.	Changes.
Exports	2,437,952	2,384,617	D. 53,335
Imports	608,347	683,135	I. 74,788

Decrease in quantity of exports, 2.2 per cent.; increase in imports, 12.3 per cent. The imports are largely of blooms, billets and other half-finished material.

Belgian Iron Production—Pig iron make in Belgium for the half-year ended June 30 was 578,380 metric tons in 1908, and 739,480 in 1909; an increase of 161,100 tons. Of the production this year 42,970 tons were foundry iron, 71,080 forge and 625,430 tons bessemer and basic pig.

Metal Markets

New York, Sept. 8—The metal markets have been dull during the week ending today and toward the close became somewhat weaker all around.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal.	Exports.	Imports.	Excess.
Gold:			
July 1909	$16,661,782	$ 3,269,885	Exp. $13,391,897
" 1908	4,845,272	2,949,179	Exp. 1,896,093
Year 1909	80,496,119	23,405,477	Exp. 57,090,642
" 1908	58,363,098	29,357,075	Exp. 29,006,172
Silver:			
July 1909	5,049,366	3,926,117	Exp. 1,123,249
" 1908	4,930,746	3,039,581	" 1,891,165
Year 1909	34,409,032	26,798,145	" 7,610,887
" 1908	30,445,291	24,180,929	" 6,264,362

Exports from the port of New York, week ended Sept. 4: Silver, $1,089,806. Imports: Gold, $140,632; silver, $121,506.

Platinum—Although an upward tendency of prices has been anticipated quotations are unchanged. Dealers are quoting $24@24.50 per oz. for refined platinum; $28.25 for hard metal and $19@21 for good scrap.

Silver—The supply of silver continues sufficient for all demands. The silver centers are well stocked, and there is no indication at present of any great rise.

SILVER AND STERLING EXCHANGE

Sept.	2	3	4	6	7	8
New York	51¾	51½	51½	.....	51½	51¾
London	23⅞	23¾	23⅞	23⅞	23¾	23⅞
Sterling Ex.	4.8650	4.8665	4.8650	.....	4.8650	4.8655

New York quotations, cents per ounce troy, fine silver; London, pence per ounce sterling silver, 0.925 fine.

Copper, Tin, Lead and Zinc

Sept.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. New York, Cts. per lb.	Lead. St. Louis, Cts. per lb.	Zinc. St. Louis, Cts. per lb.
1	13¼ @13⅜	12⅞ @13⅜	59¼	30¾ @30⅞	4.35 @4.37½	4.20 @4.25	5.57½ @5.60
2	13⅛ @13⅜	12⅞ @13	59⅛	30⅛ @30⅜	4.35 @4 37½	4 20 @4 25	5.57½ @5.60
3	13 @13⅛	12⅞ @13	59⅛	30⅛ @30¼	4.32½ @4.35	4.20 @4.22½	5.55 @5.60
4	.....	.....	....	.....	.....	.....	.....
6	13 @13⅜	12¾ @13	59	30 @30¼	4.32½ @4.35	4 20 @4 22½	5.55 @5.60
7	13 @13⅜	12¾ @13	59 1/16	30 @30¼	4.32½ @4.35	4.20 @4.22½	5 55 @5.60
8							

London quotations are per long ton (2240 lb.) standard copper. The New York quotations for electrolytic copper are for cakes, ingots and wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is usually 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—During the week Sept. 2-8 business has been quieter than for some time past. Consumers both here and in Europe are pursuing a waiting altitude, but sellers anticipate more activity after the publication of the statistics. About all of them have been offering electrolytic at 13⅛c., delivered, 30 days, which is equivalent to a little less than 13c., cash, New York, but that price has been shaded on the business that has been placed, some fairly large lots from second hands having been negotiated at a materially lower price. The situation in Lake has also been complicated by the continued offering of this class of metal by second hands at low prices, with transactions at 13c., while the producers are generally asking more and in some cases are getting it. On the decline the market has met with considerable resistance and it is not expected to go much lower. However, the close is only barely steady at 13@13⅜c. for Lake copper, and 12¾@13c. for electrolytic in cakes, ingots and wire bars. The average for casting copper has been 12⅝@12¾ cents.

Copper sheets are held at 17@18c., base for large lots. Full extras are charged, and higher prices prevail for small quantities. Copper wire is quoted at 15c. base carload lots at mill. The market is steady and a fair amount of business is being transacted.

The standard market appears to have reached a certain equilibrium, business having dwindled down to a minimum. The close is slightly lower at £59 1/16 for spot and £59 15/16 for three months. For refined and manufactured sorts we quote: English tough, £62; best selected, £61@62; strong sheets, £73@74.

Tin—The decline which has taken place from day to day throughout the week is attributed to bear selling, but the real cause is more likely the absence of demand on the part of domestic consumers. The close in London is lower at £135⅞ for spot, and £137⅛ for three months, while the ruling quotations here are 30@30⅛c.

Lead—Due to a free offering of second-hand lots and the desire to realize on the part of Missouri producers who have not taken orders for some time, the market has again declined, without bringing out an appreciable demand from consumers. The close is easy at 4.32½@4.35c., New York, and 4.20@4.22½c., St. Louis.

The London market, due to a decided revival in English demand, is somewhat higher at £12 11/16 for Spanish lead, and £12 13/16 for English lead.

Spelter—Consumers are still holding aloof, and the spelter which is coming on the market from day to day can only be placed at concessions from previous prices. The close is lower at 5.70@5.75c. New York, and 5.55@5.60c. St. Louis. The quotation at New York on the 2d and 3d inst. was 5.72½@5.75 and on Sept. 4-8 it was 5.70@5.75.

The better reports regarding the iron and steel business in Europe are in explanation of the firmness of the spelter market there, the London quotations closing again higher at £22½ for good ordinaries, and £22¾ for specials.

Other Metals

Antimony—Quotations are 8⅝@8¾c. per lb. for Cookson's, and 8@8¼c. for U. S. Business seems to be improving, and prices show an upward tendency.

Aluminum—The market remains unchanged. No. 1 ingots can be had at 20@23c. per lb. in large lots. The American maker still holds to the higher figure.

Quicksilver—There is a decidedly stronger tendency noticeable in the market and New York prices are rather unsettled. Some business is still being transacted at the old quotation of $43.50 per flask of 75 lb., but as high as $44.50 is asked by some dealers. San Francisco quotations are still $42@43 for domestic orders and $40@41 for export. London is £8 7s. 6d. per flask. Lower prices are quoted by jobbers.

Nickel—Large lots, contract business, 40@45c. per lb. Retail, spot, from 50c.

for 2000-lb. lots, up to 55c. for 500-lb. lots. The price for electrolytic is 5c. higher.

Magnesium—Quotations for the metal are $1.25 per lb., New York, in 100-lb. lots; for 5-lb. lots, $1.40 per pound.

Cadmium—Current quotations are 75c. per lb. in 100 lb. lots at Cleveland, Ohio. In Germany 450@475 marks per 100 kg., at factory in Silesia.

Spanish Metal Exports

Exports of metals and minerals from Spain, six months ended June 30, reported by *Revista Minera*, in metric tons:

Metals.	1908.	1909.	Changes.
Pig and manuf. iron	14,015	33,795	I. 19,780
Copper	5,472	9,590	I. 4,118
Copper precipitate	10,460	8,534	D. 1,926
Lead	91,587	86,242	D. 5,345
Zinc	803	860	I. 57
Quicksilver	1,487	1,480	D. 7
Minerals.			
Iron ore	3,917,076	3,758,038	D. 159,038
Manganese ore	9,997	5,629	D. 4,368
Copper ore	606,646	571,797	D. 34,849
Lead ore	1,709	1,591	D. 118
Zinc ore	53,798	62,416	I. 8,382
Pyrites	759,247	658,774	D. 100,473
Salt	348,284	359,791	I. 11,507

Imports of crude phosphate rock and basic slag, 39,447 tons in 1908, and 46,932 in 1909; imports of manufactured phosphates and fertilizers, 64,080 tons in 1908, and 50,491 this year.

Zinc and Lead Ore Markets

Joplin, Mo., Sept. 4—The highest price paid for zinc sulphide ore was $52.50 per ton, the base ranging from $47 to $50 per ton of 60 per cent. zinc. As high as $36 was paid for zinc silicate ore, the base ranging from $25 to $28 per ton of 40 per cent. zinc. The average price, all grades, was $46.88 per ton.

The highest price offering for lead ore this week was $58 per ton, but as high as $60 was paid in settlement of ore purchased ahead. At the week-end offerings had declined to $57 high, with some sales at $56. The average settling price, all grades, was $58 per ton.

Some members of the Zinc Ore Tariff Club are proceeding to form a permanent organization. It is believed that the experience gained in the tariff fight has taught producers the need of organization, and it may become effective, as other organizations were in the past, until internal disagreements split them asunder. The Ero club was effective in maintaining high prices from June, 1904, until October, 1905, after which period it lost its grip on the situation and went to pieces, making the losing legal fight on the tariff. Previous organizations have lacked stability from inertia of the most interested members.

The zinc shipment of the week is 562 tons less than the previous week and approximately 1200 tons less than the output, which is believed to be conservatively estimated at 6300 tons this week. The lead shipment is of 724 tons less, a decrease of 55 per cent.

SHIPMENTS, WEEK ENDED SEPT. 4.

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,483,250	641,420	$102,199
Joplin	1,917,350	269,950	54,928
Prosperity	769,190	73,060	20,578
Duenweg	558,840	123,020	15,193
Galena	417,370	39,770	11,070
Carthage	430,730	.....	10,552
Oronogo	405,450	.....	8,234
Alba-Neck	267,480	.....	7,889
Sarcoxie	419,360	.....	7,700
Spurgeon	295,250	22,660	7,506
Aurora	402,040	.....	7,007
Badger	271,950	.....	6,627
Zincite	253,430	4,110	6,581
Quapaw	211,260	19,050	5,411
Cave Springs	63,580	.....	1,526
Totals	10,166,530	1,193,040	$273,001
36 weeks	405,852,420	61,855,190	$9,512,394

Zinc value, the week, $238,394; 36 weeks, $7,829,293
Lead value, the week, 34,607; 36 weeks, 1,683,101

MONTHLY AVERAGE PRICES.

Month.	Zinc Ore. Base Price.		Zinc Ore. All Ores.		Lead Ore. All Ores.	
	1908.	1909.	1908.	1909.	1908.	1909.
January	$37.60	$41.25	$35.56	$38.46	$46.88	$52.17
February	36.63	36.94	34.92	34.37	49.72	50.50
March	36.19	37.40	34.19	34.71	49.90	50.82
April	35.40	38.63	34.08	37.01	52.47	55.63
May	34.19	40.06	33.39	37.42	56.05	56.69
June	33.06	44.15	32.07	40.35	60.48	57.52
July	34.55	43.06	31.67	41.11	59.90	53.74
August	36.53	48.25	33.42	44.54	60.34	57.60
September	37.63	.....	34.44	.....	54.59	.....
October	35.95	.....	33.28	.....	52.63	.....
November	39.13	.....	35.02	.....	54.53	.....
December	42.75	.....	39.63	.....	49.68	.....
Year	$36.63	.....	$34.31	.....	$53.93	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Platteville, Wis., Sept. 4—The base price of zinc ore, 60 per cent., declined to $48 per ton; the highest price paid was $50 per ton. The base price paid for lead ore, 80 per cent. was $57@58 per ton.

SHIPMENTS, WEEK ENDED SEPT. 4.

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Cuba City	322,486	172,100	74,840
Highland	420,800	50,000	.....
Platteville	625,030	.....	168,000
Days Siding	352,000	.....	.....
Hazel Green	359,900	87,700	.....
Benton	387,750	50,120	.....
Harker	257,720	.....	.....
Livingston	130,000	.....	.....
Galena	440,000	.....	.....
Shullsburg	.....	.....	.....
Strawbridge	.....	.....	.....
Rewey	65,000	.....	.....
Mineral Point	.....	.....	.....
Linden	173,570	.....	.....
Dodgeville	.....	.....	.....
Total	3,533,356	359,920	242,840
Year to Sept. 4	91,478,030	5,619,370	8,134,780

In addition to the above there was shipped to the American Zinc Ore Separating Company 313,560 lb., and to the Joplin Separator Works, 236,000 lb. zinc concentrates.

Chemicals

New York, Sept. 8—The market shows little change but the tendency is toward higher prices. Better business is anticipated.

Copper Sulphate—Prices are unchanged at $4.22½ per 100 lb. for carload lots and $4.32½@4.47½ per 100 lb. for smaller orders. Business remains quiet.

Arsenic—Prices on white arsenic are at 2.7@2.8c. per lb. The sales are light and there is considerable talk of contracts. As a consequence dealers are holding for better figures.

Nitrate of Soda—Quotations are unchanged at 2.12½c. per lb. for spot and 2.10c. for futures. The market is not active.

Mining Stocks

New York, Sept. 8—The general stock market was listless during the early part of the week. The slight recovery continued until the close of business Friday. Saturday and Monday were holidays. The reported relapse of Mr. Harriman Sunday night caused a weak and wide opening Tuesday, the Harriman stocks showing the greatest decline. Opinion is quite divided as to the immediate future of the market. The bears are making the most of Mr. Harriman's illness to depress prices. Those who favor higher prices are strengthening their position by statements referring to the complete harmony now existing among our largest financiers. The report is being circulated that Morgan is to acquire control of all Harriman securities and protect them in case the railroad magnate continues in ill health.

Conservative investors here trimmed sales, figuring that after a two years' advance in stock prices, much of the good things to come in a business way have been discounted. It is reasonably certain that our corn and wheat crops will be about average. The cotton-crop condition is now the worst ever recorded.

Because of the present high average of prices, and because of the strain on capital during the crop-moving period, there is reason for thinking an immediate advance is improbable. In summing up it may be said that at no time in the past two years have market experts been more on the fence. Common advices at present encourage a neutral attitude. The New York Curb market this week has been irregular. Its action has continued largely in sympathy with that of the New York Stock Exchange.

Boston, Sept. 7—The features in this market the past week were the strength and activity of the so-called Calumet & Hecla stocks, or those affiliated with these interests. Centennial spurted from $38.75 to $44.50, and has held the advance. Allouez rose over $7.50 to above $55, losing to $53. In the former case the addition of two stamps to its mill will give it enlarged earning power. The floating stock of both of these companies is not large, which makes it easy to mark the price up. Superior Copper and La Salle both had active periods, although the advances were of less importance. The former touched $61,

and the latter $16. Lake Copper has dropped from sight as a market leader, although fluctuations are rather extreme at times. Its variation has been from $37 to $34, with the final $35. Isle Royale spurted $2.25 to $29.75, but lost the advance on free offerings of the stock. North Butte held extremely strong, and has not varied much over $1 during the week.

The increase in the Calumet & Hecla dividend from $6 to $8 for the quarter was almost entirely unexpected, and stimulated the market for a spell, but the course of the New York market and the continued depression of the metal counteracted this influence. Atlantic has had a $2 advance to $12.25, and the buying was mainly by two brokers who recently visited the Lake Superior district. Michigan is selling at $10.50 with the $2 assessment paid.

U. S. Coal and Oil has had a $6 decline to $32 lately on offerings of the late R. D. Evans, but it is now believed that the line has been liquidated. It has recovered to above $33. There has been comparatively little doing in Amalgamated, and the price is slightly below a week back at $83. Mass showed some activity up to $9.25 on reports that a second mill run would be made shortly. U. S. Smelting has been an active feature at from $56 to $57. Curb trading has been characterized by a few active features. National Exploration had a 12c. advance to 70c. Champion ran off to 10c., recovering to 16c. H. M. Whitney's Rhode Island Coal took a start late last week and rose $2 to $12.

STOCK QUOTATIONS

NEW YORK	Sept. 8
Name of Comp.	Clg.
Alaska Mine	‡.11
Amalgamated	83
Anaconda	47⅝
Balaklala	‡2 1/16
British Col. Cop.	6⅜
Buffalo Mines	‡3⅛
Butte Coalition	25⅛
Colonial Silver	‡⅞
Cum. Ely Mining	7 1/16
Davis-Daly	6 1/16
Dominion Cop.	‡7
Douglas Copper	‡1¾
El Rayo	2¾
Florence	‡3 1/16
Foster Cobalt	‡.32
Furnace Creek	‡.05
Giroux	9⅜
Gold Hill	‡⅛
Goldfield Con.	6 1/16
Granby	‡101
Greene Gold	‡⅛
Greene G. & S.	‡9
Guanajuato	‡1¾
Guggen. Exp.	‡216⅛
Hanapah	‡15
Kerr Lake	8¾
McKinley-Dar.	.88
Miami Copper	16½
Micmac	‡⅛
Mines Co. of Am.	‡⅛
Montezu. of C. R.	‡25
Mont. Sho. C.	2¼
Nev. Utah M. & S.	1⅞
Newhouse M. & S.	3⅝
Nipissing Mines	10¾
Old Hundred	‡⅛
Silver Queen	.42
Stewart	‡7/16
Tennessee Cop'r.	‡39
Tri-Bullion	‡1
United Copper	10¾
Utah Apex	‡4⅛
Utah Copper	49⅝
Yukon Gold	5⅛

‡Last quotation.

BOSTON	Sept. 8
Name of Comp.	Clg.
Adventure	7
Allouez	53¾
Am. Zinc	‡31⅛
Arcadian	4½
Arizona Com.	43⅛
Atlantic	11¾
Boston Con.	14⅝
Calumet & Ariz.	105¾
Calumet & Hecla	680
Centennial	43½
Copper Range	81½
Daly-West	9
East Butte	11¾
Franklin	16½
Greene—Can.	9½
Hancock	9⅜
Isle Royal	26¾
Keweenaw	3½
La Salle	15¾
Mass	9
Michigan	10½
Mohawk	64
Nevada	24¾
North Butte	60½
Ojibway	10½
Old Colony	60
Old Dominion	.56¾
Osceola	146
Parrot	33⅛
Quincy	90
Rhode Island	‡4⅜
Shannon	16⅛
Superior	58½
Superior & Bost.	16
Superior & Pitts.	16⅛
Tamarack	‡65
Trinity	12¼
U. S. Smg. & Ref.	56⅞
U.S.Sm. & Re., pd.	52
Utah Con.	45¾
Victoria	3⅜
Winona	6
Wolverine	155
Wyandotte	2½

‡Last quotation.

N. Y. INDUSTRIAL	
Am. Agri. Chem.	46⅛
Am. Smelt. & Ref.	98½
Am.Sm. & Ref., pf.	114
Colo. Fuel & Iron	43⅜
Federal M. & S., pf.	‡91½
National Lead	90¾
National Lead, pf.	‡112
Pittsburg Coal	21¾
Republic I. & S.	38½
Republic I. & S., pf.	105¼
Sloss-Sheffield	85
Standard Oil	‡685
U. S. Steel	78⅝
U. S. Steel, pf.	126
Va. Car. Chem.	47¼

BOSTON CURB	Low.
Ahmeek	215
Chemung	15¼
Chino	7⅝
Globe Con	4½
Gila	9½
Mason Valley	2
Ray Central	2 13/16
Ray Con	19
San Antonio	8½
Yuma	2¾

Furnished by Hornblower & Weeks, N. Y.

ST. LOUIS	Sept. 4	
N. of Com.	High.	Low.
Adams	.40	.30
Am. Nettie	.09	.07
Center Cr'k	2 00	1.75
Cent.C.&C.	85.00	83.00
C.C. & C. pf.	83.00	82.00
Cent. Oil	115.00	100.00
Columbia	9.00	7.00
Con. Coal	20.00	19 00
Doe Run	115.00	105.00
Gra. Bimet.	.27	.23
St. Joe	12.50	11.50

LONDON	Sept. 8		
Name of Com.	Clg.		
Dolores	£1	5s	0d
Stratton'sInd.	0	3	3
Camp Bird	1	9	0
Esperanza	3	1	3
Tomboy	1	1	3
El Oro	1	5	6
Oroville	1	2	6

Cabled through Wm. P. Bonbright & Co., N. Y.

NEVADA STOCKS. Sept. 8.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS		Silver Pick	.14
Belcher	.91	St. Ives	.06
Best & Belcher	.61	Triangle	.01
Caledonia	.35	BULLFROG STOCKS	
Chollar	.26	Gibraltar	.02
Comstock	.28	Homestake King.	...
Con. Cal. & Va	1.42	Mont. Shoshone C.	2 12½
Crown Point	1.20	Tramp Cons	.04
Exchequer	.33	MISCELLANEOUS	
Gould & Curry	.27	Cumberland Ely	7.00
Hale & Norcross	.43	Giroux	9.00
Mexican	1.27	Greenwa'r Copper	.03½
Ophir	1.30	Nevada Con	24.25
Overman	.46	Nevada Hills	.70
Potosi	58	Navada Smelting	.87½
Savage	.52	Nevada Wonder	.60
Sierra Nevada	.50	Nevada-Utah	1.75
Union	.54	Penn-Wyoming	...
Utah	.09	Pittsburgh S. Pk.	.50
Yellow Jacket	1 27	Ray Central	2.68¾
TONOPAH STOCKS		Ray Con	18.00
Belmont	.80	Round Mt. Sphinx	05
Extension	.60		
Golden Anchor	...		
Jim Butler	.14		
MacNamara	.30		
Midway	.20		
Montana	.99		
North Star	.02		
Tono'h Mine of N.	6.75		
West End Con	.28		
GOLDFI'D STOCKS			
Adams	.01		
Atlanta	.14		
Blue Bell	.03		
Booth	.12		
C.O.D. Con	.10		
Columbia Mt.	.09		
Comb. Frac.	.82		
Con. Red Top	...		
Cracker Jack	.01		
Dia'dfield B. B. C.	.02		
Goldfield Belmont	.04		
Goldfield Daisy	15½		
Great Bend	06		
Jumbo Extension	17		
Kendall	02		
Lone Star	.03		
May Queen	04		
Oro	.05		
Red Hill	06		
Sandstorm	.06		

COLO. SPRINGS	Sept. 3
Name of Comp.	Clg.
Acacia	.08⅜
C. C. Con	‡ 03⅛
Dante	‡.07
Doctor	.10
Elkton	.75
El Paso	.67
Findlay	.11
Gold Dollar	.13½
Gold Sovereign	.04⅝
Isabella	.22⅜
Jack Pot	‡.08½
Jennie Sample	.08
Jerry Johnson	‡.06¼
Lexington	.01⅜
Mary McKinney	.47
Pharmacist	.03⅜
Portland	.83¾
U. G. M.	.08⅜
Vindicator	.70¾
Work	.08

Assessments

Company.	Delinq.	Sale.	Amt.
Alta Gladstone, Utah	Sept. 15	Oct. 20	$0.00½
Andes, Nev	Sept. 14	Oct. 5	0.10
Arcadian, Mich	Sept. 1	Sept. 31	0.50
Boulder Cr'k M. & M., Wash.	Aug. 31	Sept. 30	0.01
Brown Stone, Utah	Aug. 16	Sept. 14	0.00½
Copper Mt. M. & D., Ida	Sept. 7	Oct. 4	0.003
Crown Point, Nev	Aug. 21	Sept. 17	0.10
East Buffalo, Ida	Sept. 10	Oct. 10	0.000½
Exchequer, Nev	Aug. 16	Sept. 13	0.05
Golden Winnie Tungsten, I.	Aug. 23	Sept. 15	0.001
Hancock Con., Mich	Oct. 10		1.00
Hypotheek, M. & M., Ida	Aug. 26	Sept. 25	0.005
Laclede, Ltd, Ida	Aug. 23	Sept. 21	0.003
Lady Washington, Nev	Aug. 31	Sept. 20	0.05
Massasoit, Utah	Aug. 21	Sept. 14	0.00½
Mexican, Nev	Sept. 10	Oct. 4	0.10
New Hope, Ida	July 15	Sept. 25	0.002
Pittsburg Con., Utah	Aug. 20	Sept. 17	0.01
Springfield M. Co. Ltd, Ida.	Aug. 13	Sept. 13	0.002
West Century M. & M., Utah	Aug. 31	Sept. 17	0.01
Winona, Mich	Sept. 14		1.00

Monthly Average Prices of Metals

SILVER

Month.	New York.		London.	
	1908.	1909.	1908.	1909.
January	55.678	51.750	25.738	23.834
February	56.000	51.472	25.855	23.706
March	55.365	50.468	25.570	23.227
April	55.505	51.428	25.133	23.708
May	52.795	52.905	24.377	24.343
June	53.663	52.538	24.760	24.166
July	53.115	51.043	24.514	23.519
August	51.683	51.125	23.858	23.588
September	51.720	.....	23.877	.....
October	51.431	.....	23.725	.....
November	49.647	.....	22.933	.....
December	48.766	.....	22.493	.....
Total	52.864	.....	24.402	.....

New York, cents per fine ounce; London, pence per standard ounce.

COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1908.	1909.	1908.	1909.	1908.	1909.
January	13.726	13.893	13.901	14.280	62.386	57.688
February	12.905	12.949	13.098	13.295	58.786	61.198
March	12.704	12.387	12.875	12.826	58.761	56.231
April	12.743	12.56½	12.928	12.93¾	58.331	57.363
May	12.598	12.893	12.788	13.238	57.387	59.338
June	12.675	13.214	12.877	13.548	57.842	59.627
July	12.702	12.880	12.933	13.363	57.989	58.556
August	13.462	13.007	13.639	13.296	60.500	59.393
September	13.388	.....	13.600	.....	60.338	.....
October	13.354	.....	13.646	.....	60.139	.....
November	14.130	.....	14.386	.....	63.417	.....
December	14.111	.....	14.411	.....	62.943	.....
Year	13.208	.....	13.424	.....	59.902	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

TIN AT NEW YORK

Month.	1908.	1909.	Month.	1908.	1909.
January	27.380	28.060	July	29.207	29.125
February	28.978	28.290	August	29.942	29.966
March	30.577	28.727	September	28.815	.....
April	31.702	29.445	October	29.444	.....
May	30.015	29.225	November	30.348	.....
June	28.024	29 322	December	29.154	.....
			Av. Year	29.465	.....

Prices are in cents per pound.

LEAD

Month.	New York.		St. Louis	London.	
	1908.	1909.	1909.	1908.	1909.
January	3.691	4.175	4.025	14.469	13.113
February	3.725	4.018	3.868	14.250	13.313
March	3.838	3.986	3.835	13.975	13.438
April	3.993	4.168	4.051	13.469	13.297
May	4.253	4.287	4.214	12.938	13.225
June	4.466	4.350	4.291	12.600	13.031
July	4.744	4.321	4.188	13.000	12.563
August	4.580	4.363	4.227	13.375	12.475
September	4.515	.....	.....	13.125	.....
October	4.351	.....	.....	13.375	.....
November	4.330	.....	.....	13.538	.....
December	4.213	.....	.....	13.156	.....
Year	4.200	.....	.....	13.439	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month.	New York		St. Louis.		London.	
	1908.	1909.	1908.	1909.	1908.	1909.
January	4.513	5.141	4.363	4.991	20.563	21.425
February	4.788	4.889	4.638	4.739	20.875	21.563
March	4.665	4.757	4.527	4.607	21.075	21.438
April	4.645	4.965	4.495	4.815	21.344	21.531
May	4.608	5.124	4.458	4.974	19.906	21.975
June	4.543	5.402	4.393	5.252	19.000	22.000
July	4.485	5.402	4.338	5.252	19.031	21.969
August	4.702	5.729	4.556	5.579	19.350	22.125
September	4.769	.....	4.619	.....	19.563	.....
October	4.801	.....	4.651	.....	19.750	.....
November	5.059	.....	4.909	.....	20.875	.....
December	5.137	.....	4.987	.....	20.625	.....
Year	4.726	.....	4.578	.....	20.163	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.